SONY®

Manual de Treino

Color Television

BA-4 Chassis

Circuit Description and Troubleshooting

Course: CTV-25R1

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Introduction

Sony TV Models Covered by this Manual

BA-4 Chassis – Current Models Covered			
KV13M40	KV20M40	KV27S40	KV27V40
KV13M50	KV20M40	KV27S45	KV27V45
KV13M51	KV20S40	KV27S65	KV27V65
	KV20S41		
	KV20V80		

Purpose

The purpose of this book is to:

- Show through diagrams and explanation how the Sony Trinitron Picture tube now works because it has evolved since inception in 1968.
- Provide organized, simplified diagrams that provide an insight to understanding the necessities of the circuit's operation. This is an essential aid to rapidly determining the cause of a failure.
- Explain the circuit operation and provide tips for troubleshooting where needed. Some parts of the circuit are used only under certain conditions of operation. It is important to know when these additional parts affect the main circuit during operation and how they affect the main circuits if they are defective.
- Provide some voltages from a working production run set that are not supplied in the service manual. These can be compared to the non-working unit you are repairing to determine where the fault is.
- Explain the new self diagnostic circuit:
    1. How to access it
    2. How it works,
    3. When to use it
    4. The circuits that support it

Note:
This note is common to all schematics and block diagrams.
All capacitors are *uf* unless otherwise noted.
All resistors are *ohms* unless otherwise noted.
All voltages are *dc* unless otherwise noted.

The Trinitron® Picture Tube

The Cathode Ray Tube (CRT) has been slowly changing since its conception about 50 years ago. Since then the emitter, accelerator and focus structures at the “gun” end have been added to the vacuum tube to shape and control the amount of electrons from the gun.

At the target end of the CRT, the luminescent screen is made of a phosphor mixture. Phosphor glows white when struck by electrons. Phosphor brightness is directly proportional to the amount of electrons that strike the phosphor. The CRT sport brightness was controllable with a gun and phosphor screen.

The electron beam produced a spot of light that was stationary on the phosphor screen. Placing an electromagnetic field near the electron beam after it left the gun created movement. The spot intensity and location were now controllable and the CRT became known as the picture tube.

To produce a color picture on the CRT screen; three independent gun structures are used. The electron guns produce different amounts of electrons targeted to their corresponding Red, Green and Blue phosphors. Red, Green and Blue are the primary colors for light.

In 1968 the Sony Trinitron picture tube was a departure from the traditional three-gun color picture tube. Three major changes to the old color tube created a distinctive Trinitron picture tube:

1. Instead of three small electron guns, focus was improved using one large electron gun structure that all three beams pass through.
2. Electrostatic convergence plates were added to bend the outer electron beams so they would land on the corresponding red and blue color phosphor.
3. A continuous vertical slotted aperture grill at the screen end that:

- Reduces the effects of terrestrial magnetism.
- Prevents adjacent and stray electrons from striking the wrong phosphor.
- Allows more electrons to pass, increasing brightness without shortening life.
- Results in a flat screen. This reduces annoying room light reflections (glare).

The remainder of this document is divided into four sections explaining the construction of Trinitron tube as an aid to the service technician:

- The Trinitron Electron Gun Operation
- The Trinitron Screen
- Picture Tube Defect Symptoms
- Picture Tube Handling and Vacuum Disposal

The Trinitron Electron Gun Operation

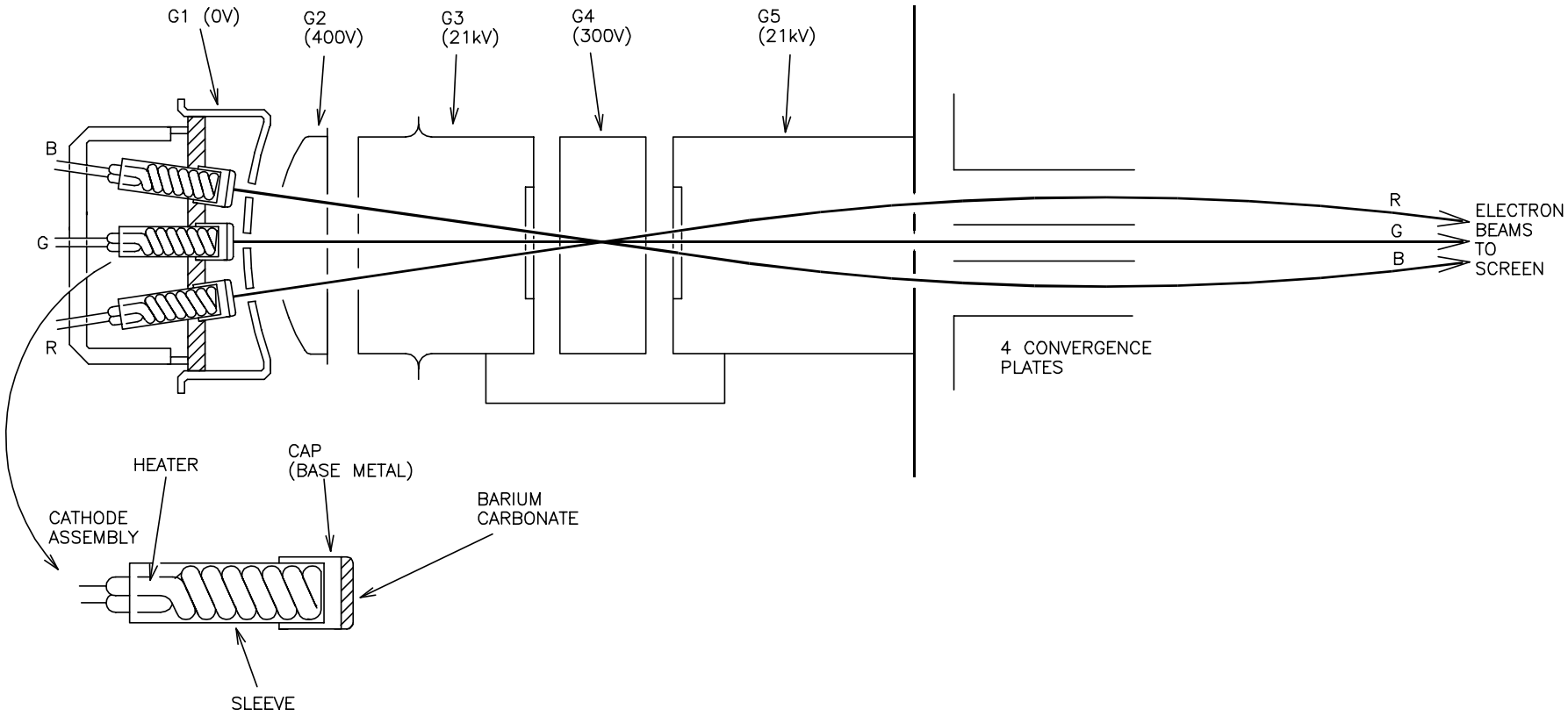
The Sony Trinitron electron gun consists of three cathode assemblies, five grid structures and convergence plates:

Three cathode assemblies

When heated, electrons are given off from a Barium Carbonate ($BaCO_3$) surface deposited onto a cap. The cap serves as a holder for the $BaCO_3$, white mixture. The cap is fastened to a sleeve that houses a heating element (filament). This assembly is called a cathode.

There are three cathodes in the beginning part of the gun assembly by the pins of the CRT. They all supply electrons in controlled amounts. The center cathode on the Trinitron tube produces the amount of electrons that correspond to the green color information. These electrons will eventually land on the green phosphor if things go well on the journey. The outer cathodes are angled slightly to send electrons through the gun structure. Their final targets are the red and blue phosphor at the screen.

Next a voltage is connected to the cathode (sleeve) and a more positive voltage to the second grid (two) in the gun structure. This difference in potential will pull the electrons from the cathode’s Barium Carbonate ($BaCO_3$) surface into the gun structure. The difference in potential voltage between the cathode and grid two will determine the amount of electrons emitted. More electrons landing on the phosphor (screen) will increase the color spot intensity.



TRINITRON ELECTRON GUN

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Five Grid Structures

The electron gun consists of the cathode and several metal rings called grids. The grid name came from the controlling grids in a vacuum tube where the interelectrode elements were originally shaped like a screen mesh. There is no structural resemblance between the picture and vacuum tube grids. In the picture tube, the grid rings are applied different electrical potentials to focus (shape) and accelerate (speed) the electrons from the cathodes. Each part of the gun has a voltage applied to it for a specific purpose.

Trinitron Electron Gun Parts

Name	Purpose	Applied Voltage
Filament / Heater (Inside the cathode assembly).	Brings the cathode to emission temperature.	Test voltage = 6 Vdc @ 0.64 Amp. Actual voltage = FBT pulse, 6V rms.
Cathode assembly	Houses the electron emitting chemical and the heater.	R, G or B signal voltage. +200V= Cutoff. No electrons output. 0V = All electrons output.
Grid 1 / Control Grid	Reference potential for cathode emission.	Ground via current limiting resistor.
Grid 2 / Screen Grid	Brightness limit.	400Vdc (approx.)
Grid 3 / Accelerating	Accelerate stream.	HV from FBT*.
Grid 4 / Focus	Sets focus point.	300Vdc (approx.) Focus Control range = 200Vdc to 1kVdc.
Grid 5 / Accelerating	Post Accelerating.	HV from FBT*.

*FBT = Flyback Transformer in consumer TVs. Transformer is assembled with rectifiers in a doubler or tripler configuration to develop 25-35kV of DC. The high voltage is used in the picture tube to accelerate electrons. Larger picture tubes require a higher high voltage from the FBT to move the electrons a longer distance.

Control Grid One

Electrons at the cathode are attracted to a positive potential. The grid one ring is the next electrode structure in the electron gun. In consumer TVs, grid one is fixed at a 0Vdc potential for reference. If a positive potential were placed on the cathode, electrons would not be attracted to grid one. At a +200Vdc potential, electrons would not leave the cathode. If no electrons enter the gun, the TV screen is dark. The picture tube is said to be in “cutoff”.

On the other hand, placing the cathode at the same potential as grid one (0Vdc) is the same as if grid one were invisible. The maximum amount of electrons is attracted toward the positive grid two structure, resulting in maximum screen brightness.

By varying the voltage at the cathode from 0 Vdc to +200Vdc (cutoff), the amount of electrons available to the gun structure to produce screen brightness can be controlled.

Screen Grid Two

The higher voltage at the second grid ring accelerates the electron beam. This voltage is connected to the TV circuitry’s “screen control”. The screen control is adjusted to limit the maximum beam acceleration (brightness). This limit avoids over driving the tube which shortens the life of the cathodes and phosphors.

Acceleration Grid Three

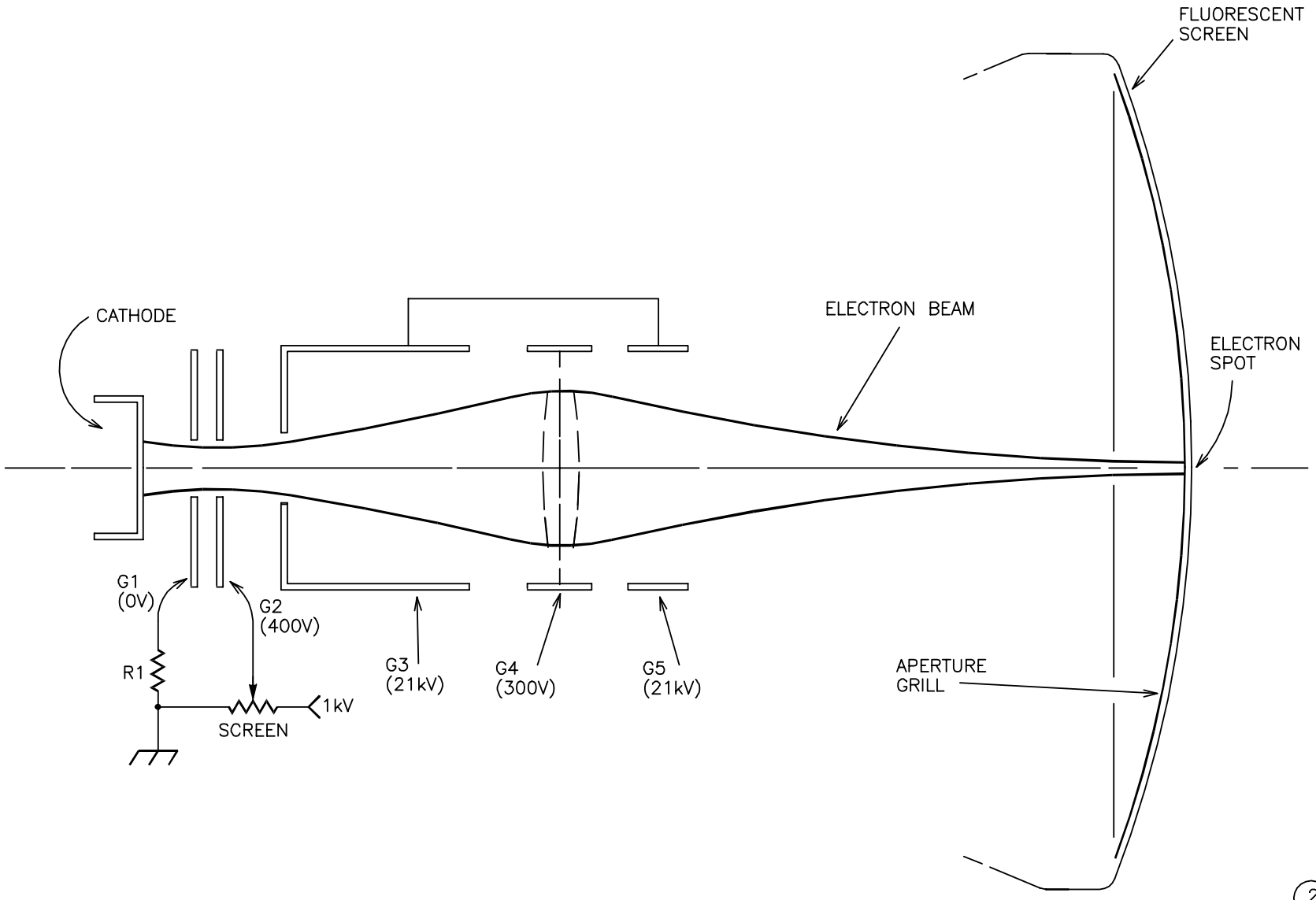
The very highest voltage in a TV (from the flyback transformer) is applied to the third grid ring. This creates a large magnetic field to further accelerate the three electron streams from the cathodes.

Focus Grid Four and Acceleration Grid Five

The lower voltage at focus grid ring four slows down the electron stream so they bunch up, thickening the beams. By varying the focus voltage applied to grid four, the beam thickness is controlled. A thicker beam means the electron stream will focus at a point closer to the gun (before the screen).

When a very bright spot is called for, more electrons are sent from the cathodes. As a result the beam is at its thickest at the G4 focus ring. In a small electron gun, the G4 focus ring is closer to the thick beam than the single Trinitron gun where the focus ring is much larger.

Grid four’s magnetic field is the strongest at the metal grid ring. More peripheral electrons are attracted to the focus grid ring of the smaller electron gun. Some of these peripheral electrons are lost from the stream as G4 grid current, limiting beam thickness. The limited beam thickness results in a shift in focus point. This causes reduced focus during brightness peaks in the smaller electron gun. Therefore, at high brightness levels it is advantageous to have a large G4 focus structure. A wider dynamic focus range is achievable with the large single Trinitron gun.



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GRID STRUCTURES

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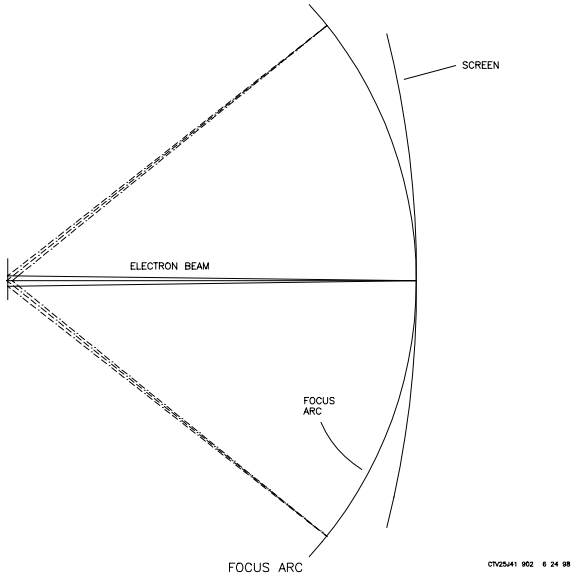
Grid ring five is applied a very high voltage to accelerate the beam so it comes to a fine point some distance away (at the center of the screen). The ratio of voltages at G4 and G5 determines where the focus point is positioned. This focus point forms an arc when the electron beam is swept from left to right by the deflection yoke.



Unfortunately, the picture tube screen does not match this focus arc, so the beam will only be in focus at the center of the screen. To correct this physics problem, the G4 focus grid voltage is modulated with a parabolic waveform (shape is like a bowl) at the horizontal rate. The parabolic waveform moves the focus points forward so they match the screen.

In a TV, high voltage drops during bright scenes because of heavy current demands. When the high voltage applied to grid five drops, the G4-G5 focus voltage ratio changes. This voltage change causes the focus point to change during the brightest spots. One method to maintain the focus voltage ratio is to take both the focus voltage for G4 and high voltage for G5 from the same flyback secondary transformer winding. If G5's high voltage drops, so does the G4 focus voltage. The focus voltage ratio and picture focus are maintained during bright scene changes.

The focus is customarily adjusted for sharpness when snow (no station) is present. The rapid changes from black to white when snow is displayed on the screen are the most taxing on the high voltage system. Setting the focus under these dynamic conditions will insure a well focused picture within the normal viewing range.

Convergence Plates

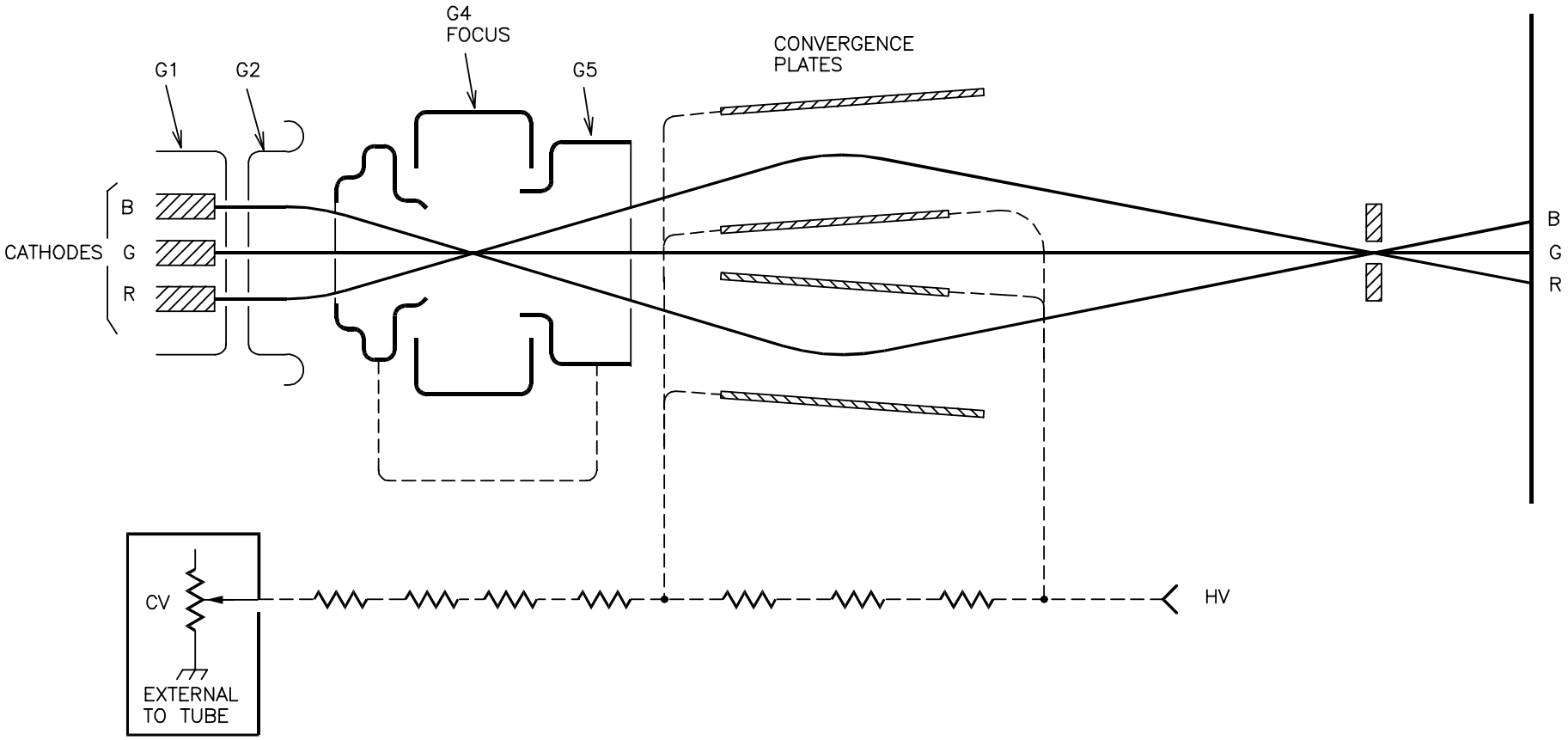
The Trinitron gun uses one gun, which three electron beams pass through. These three beams diverge as they pass out of the gun. Electrostatic convergence plates bend the outer electron beams back so they land adjacent to the center electron beam on the corresponding red and blue phosphors.

Four convergence plates are used to bend the outer electron beams. The two center plates are connected to the flyback generated high voltage. The two outer plates are connected to a voltage a few hundred volts less than the high voltage. A variable resistor (CV) external to the picture tube determines the exact voltage.

As the outer two electron beams pass through the convergence plates, they are bent (attracted) inward toward the higher voltage plate. Adjusting the CV control changes the voltage to the outer convergence plates. The deflection angle of the outer beams can be changed so they converge and pass through the same aperture grill slot by the screen as the center green beam. After the beams pass the aperture grill, they diverge to land on their corresponding red, green and blue phosphors to produce a white dot.

An incorrect adjustment of this CV control causes the outer beams to pass through other slots in the aperture grill. The outer beams will produce a red and blue dot near the green one instead of a single white dot.

There is no CV control in newer Sony TV sets. The CV control end of the picture tube's high voltage resistor is grounded so there is still a difference in convergence plate potiential. Plastic rings with tabs called "V-Stat" control permit you to magnetically perform the same static convergence as the CV control. These plastic rings are located at the back of the yoke and contain a few small pieces of metal molded into the plastic. This metal alters the yoke's magnetic field for beam convergance.



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CONVERGENCE PLATES

The Trinitron Screen

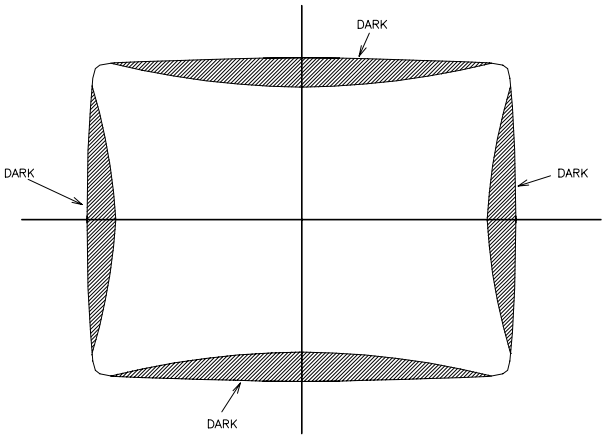
In front of the electron gun are the:

- Deflection Yoke
- Aperture Grill (AG)
- Phosphor Stripes
- Getter Assembly

Deflection Yoke

The yoke consists of two coils of wire mounted on the glass bell of the picture tube in front of the (internal) convergence plates. One coil generates a magnetic field to move the electron beams in the X-axis and the other coil moves the beams in the Y-axis. Guided by the deflection yoke, three electron beams first sweep across the aperture grill along the X-axis from left to right (from the front as you would watch TV). At the end of the horizontal sweep, the beam retraces back to the left side of the screen. Meanwhile the yoke's magnetic field moves the three beams down (Y-axis) one line before the beams sweep horizontally across the aperture grill again. This process then repeats. Finally, at the bottom right corner of the picture, the beams are returned to the top left corner of the screen.

The deflection yoke has difficulty providing a magnetic field to sweep the beam so it matches the screen shape. The yoke's magnetic field is stronger at the corners of the picture then at the top/bottom and sides (X & Y-axis).



Improvements in deflection yoke construction have compensated for the reduced top/bottom deflection (Y-axis). Along the X-axis, the weaker magnetic field causes the picture to look like an hourglass. This is because there is insufficient picture scan, which produces a dark area at the left and right sides of the picture tube.

Increasing the current through the horizontal windings of the yoke compensates for this hourglass picture. The yoke current is then gradually increased line by line until the middle of the picture for maximum width , the curve is reduced as the beam continues to scan downward. The result is a straight picture. This type of yoke distortion to the picture is called pincushion distortion. The correction circuit that changes the yoke current is called the pincushion stage.

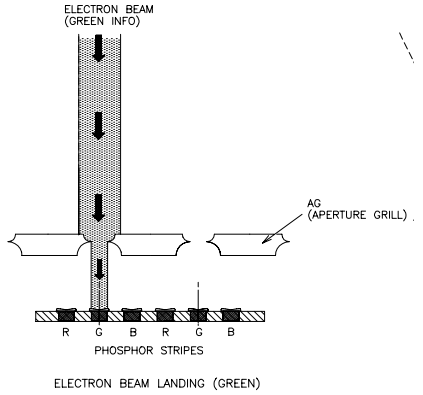
Aperture Grill Construction

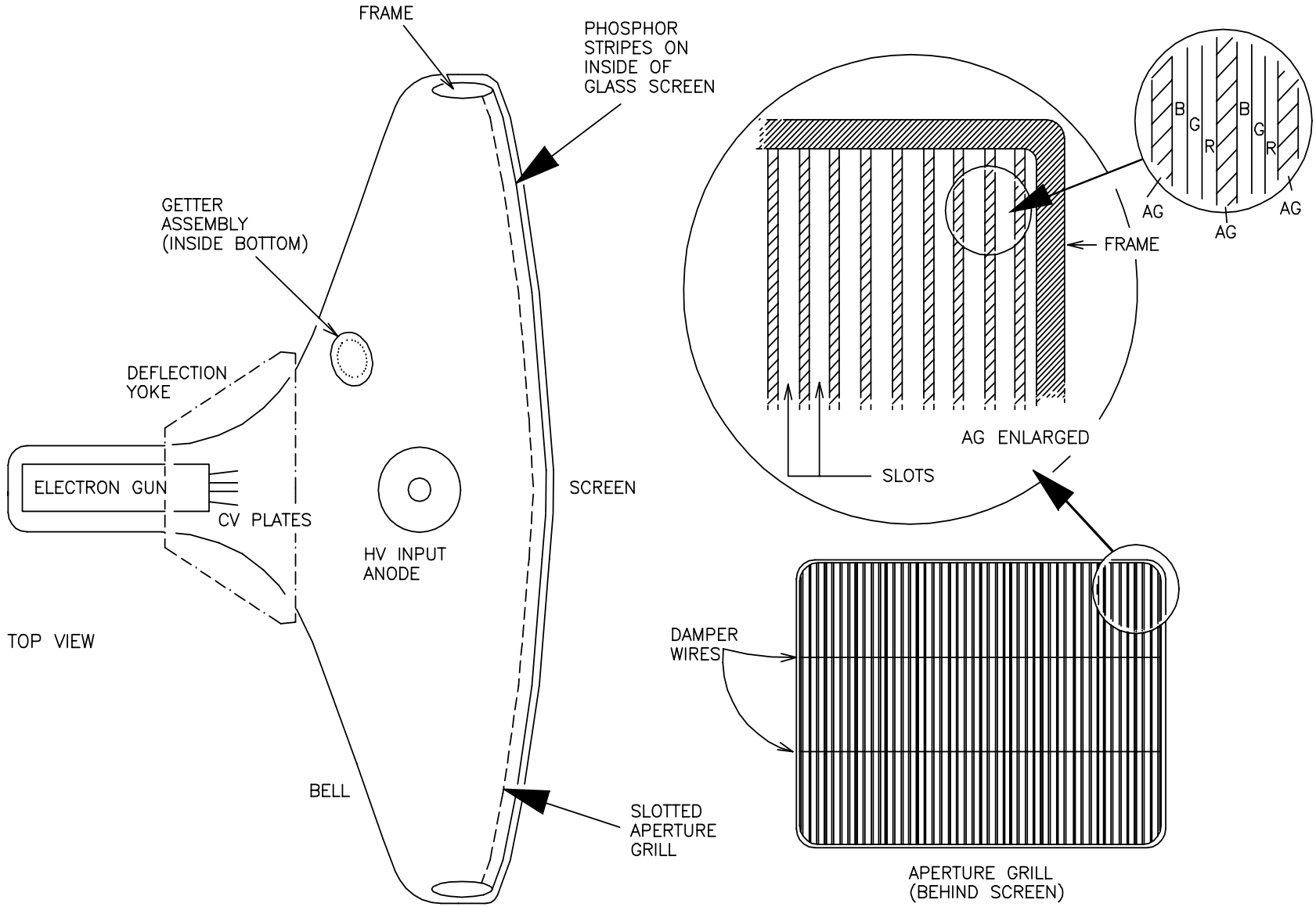
The aperture grill (AG) is an aluminum panel located behind the picture tube screen with vertical slits cut out. The aperture grill is welded to a steel frame that holds it completely flat in the vertical direction and curved in the horizontal direction. Consequently, the resultant picture tube face shape is like the front of a cylinder. This flatter surface reflects less room light and, therefore, produces fewer glares from the ambient light. This is another feature that sets the Trinitron apart from other picture tubes that are spherical in shape.

Although the grill is held flat, it still can move slightly, especially in larger tubes. In larger tubes, there are two horizontal wires that run across equidistant across the grill, preventing the slots from vibrating or shifting. These two wires found in the grill are called anti-vibration damper wires.

Aperture Grill Purpose

In diagram 5, the slits in the aperture grill allow the electron beam to pass through and land on the phosphor. The electron beam meant to land on the green phosphor is shown:





TRINITRON PICTURE TUBE

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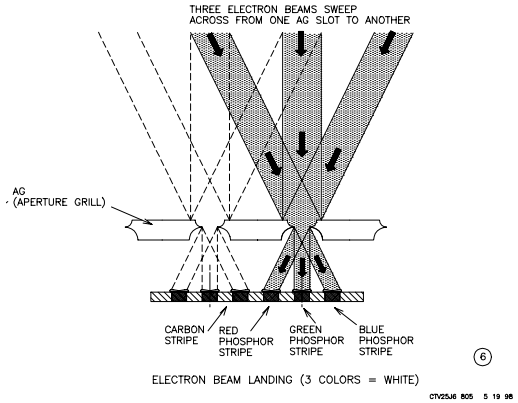
In diagram 6 you can see the slits have a more important purpose. When all three beams are turned ON, the narrow AG slots prevent adjacent electron beams from landing on the wrong color phosphor. The aperture grill slots only allow electron beams to pass through and land on their corresponding color phosphor.


THREE ELECTRON BEAMS SWEEP ACROSS FROM ONE AG SLOT TO ANOTHER
AG (APERTURE GRILL)
CARBON STRIPE
RED PHOSPHOR STRIPE
GREEN PHOSPHOR STRIPE
BLUE PHOSPHOR STRIPE
ELECTRON BEAM LANDING (3 COLORS = WHITE)
6
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Phosphor Stripes

Phosphor is a powder that becomes luminescent when bombarded by electrons. The color and persistence of phosphor glow after electron bombardment is determined by using additional chemicals combined with the phosphor. Three different color phosphors are painted in vertical strips that correspond to aperture grill slits. The phosphor strips are separated by carbon stripes that do not glow when struck by electrons. These carbon stripes allow for manufacturing tolerances when making the AG and painting the phosphor stripes.

Getter Assembly

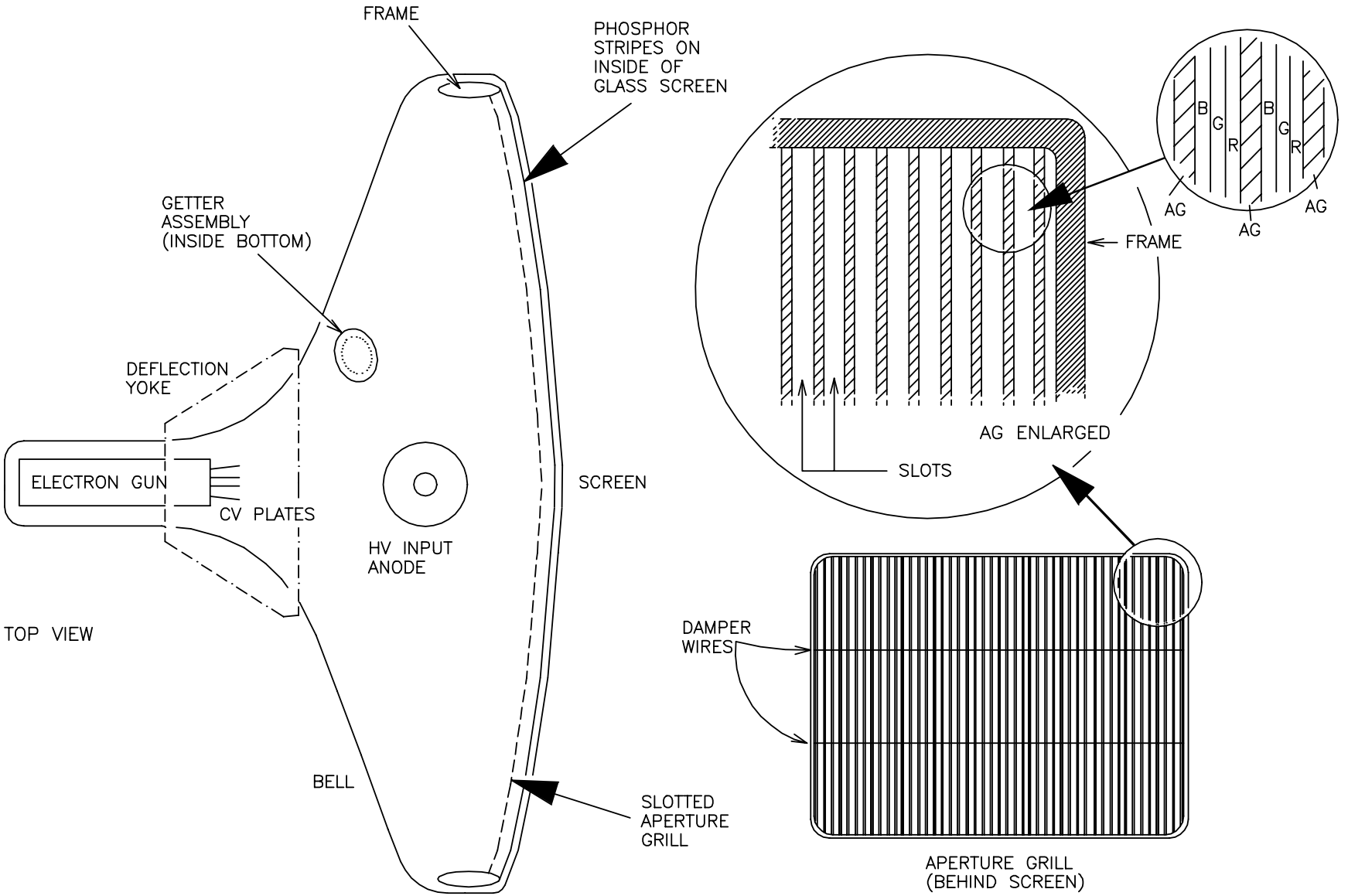
Electron emission efficiency and cathode life are greatly dependent upon a clean environment inside the CRT. After the air is pumped out of the CRT and sealed, residual water vapor, carbon dioxide and oxygen inevitably remain.

A small cup attached to the gun assembly containing a barium compound is placed inside the picture tube. After sealing the glass picture tube, the Getter is ”flashed” with a high level of RF energy. The barium compound heats up and evaporates, combining with the residual undesirable elements in the picture. The resultant compounds that are created coat the inside walls of the picture tube without consequence. The result is a longer tube life because of the cleaner environment.

Picture Tube Defect Symptoms

Several problems can occur in new picture tubes. The bench technician can solve some problems and avoid a picture tube replacement.

Defective Picture Tube Symptoms			
Symptom	Suspect	Check	Procedure
Dark picture or one color missing.	Heaters Open	Apply 6Vdc to the heater terminals. Some heaters are connected in parallel, others in series but all take 6Vdc.	Clean the CRT pins and examine the socket for corrosion. Apply 6Vdc to the CRT heater pins, looking for a glow in all 3 heaters. Then if a heater(s) does not glow, replace the picture tube.
Dark picture	Grid 1 to Grid 2 short.	There should be infinite resistance between the G1 and G2 pins.	1. Unplug TV and remove video board. 2. Apply 15-20Vdc between the G1 and G2 pins to vaporize the short. Current limit the power supply to 1 Amp.
Bright red, green or blue picture One color retrace lines may be present. Retrace lines are diagonal lines that run from lower left to the upper right corner.	Heater – Cathode short. OR Cathode to Grid 1 short.	Remove the R, G or B video output transistor of that bright color. If that color is still bright, the tube is bad. There should be infinite resistance between any CRT pin to either Heater pin. *	1. Unplug TV & remove the video board. 2. Apply 15-20Vdc between the pins that show resistance to vaporize the short. * Current limit the external power supply to 1 Amp.



TRINITRON PICTURE TUBE

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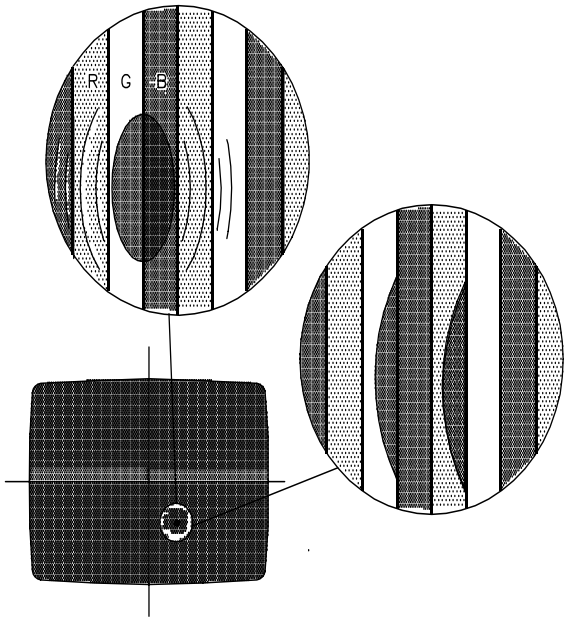
Defective Picture Tube Symptoms			
Symptom	Suspect	Check	Procedure
Bright picture with retrace lines and/or poor focus.	Grid 2 to high voltage Grid 3 leakage.	Symptom is that all three colors are bright.	Reduce G2 / screen voltage to the lowest setting. Vary focus control to both limits several times. Put on safety apparel. Place the tube face down and lightly tap the neck to dislodge the particle.
Black spot on the screen. (see black spot diagram)	Dust lodged in the aperture grill.	Generate a white raster. Inspect grill with magnifying glass.	Mark location and pull TV. Follow safety instructions. Apply light impact with rubber mallet (see diagram).
RGB Rainbow. (see rainbow picture)	Aperture grill was unseated in transit.	Rainbow of colors can start at the top or bottom (bottom rainbow shown).	A loose aperture grill is dangerous and may cause tube implosion. Use all safety precautions. Do not jar set. Transport face down,.
Purity / Beam landing is off.	The TV's degaussing circuit did not demagnetize aperture grill metal support.	Same color blotches remain at that area of the screen regardless of picture screen changes.	**Do not manually Degauss the picture tube with your strong degaussing coil **.** Repair the TV's degaussing circuit. The thermistor is usually at fault.

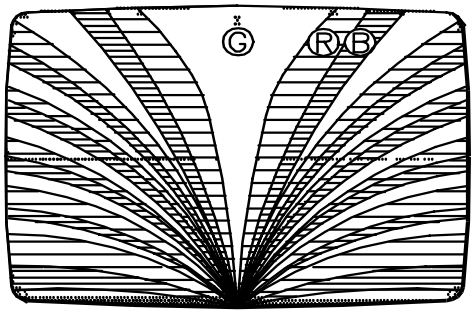
* Only the heater pins should have resistance. All other pins have infinite (∞) resistance to each other and to either heater pins.

Highly-used picture tubes that have a heater-cathode leakage/short have a low restoration success level.

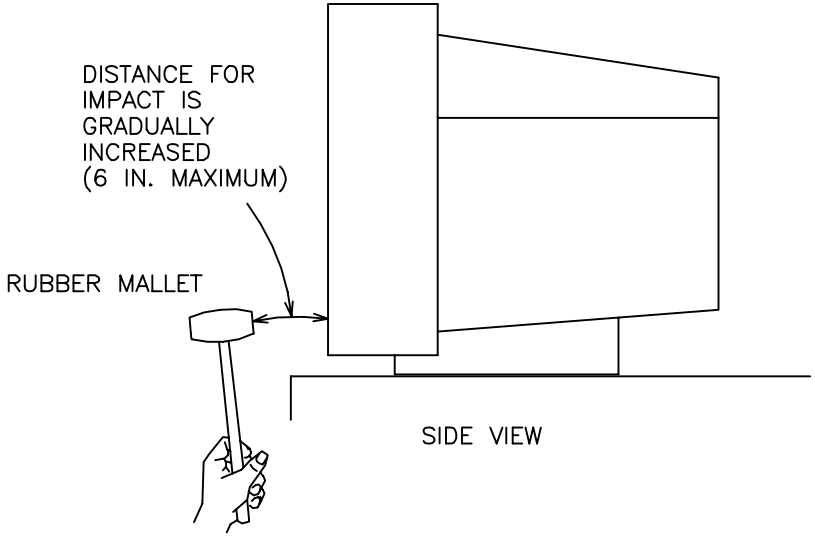
** Do not manually Degauss. New 27' – 35" picture tubes are magnetically "conditioned" for optimum beam landing. Strong manua degaussing will destroy this conditioning. Applying disc magnets (P/I = 1-452-094-00) to the bell of the picture tube is the only way to compensate for lost magnetic conditioning. The Sony manual degaussing tool can be used to degauss these tubes because of the reduced field intensity (P/N = 7-700-781-01).



BLACK DUST SPOT ON THE PICTURE TUBE'S APERTURE GRILL



RGB RAINBOW (UNREPAIRABLE)



DISLODGE THE DUST PARTICLES WITH A RUBBER MALLET

Picture Tube Handling and Vacuum Disposal

Once you have determined that the CRT is inoperative, air should be let into the tube. This will reduce the risk of implosion caused by a sudden loss of vacuum.

There are two good methods of "airing" the tube:

A. Puncture through the anode button.
B. Break the thin glass seal at the neck.

The first method allows air to enter the tube gradually.

A. Puncture through the anode button.

Air can be let in gradually by making a hole inside the high voltage anode. The anode is located at the stronger bell part of the picture tube. ***Read the procedure below first:***

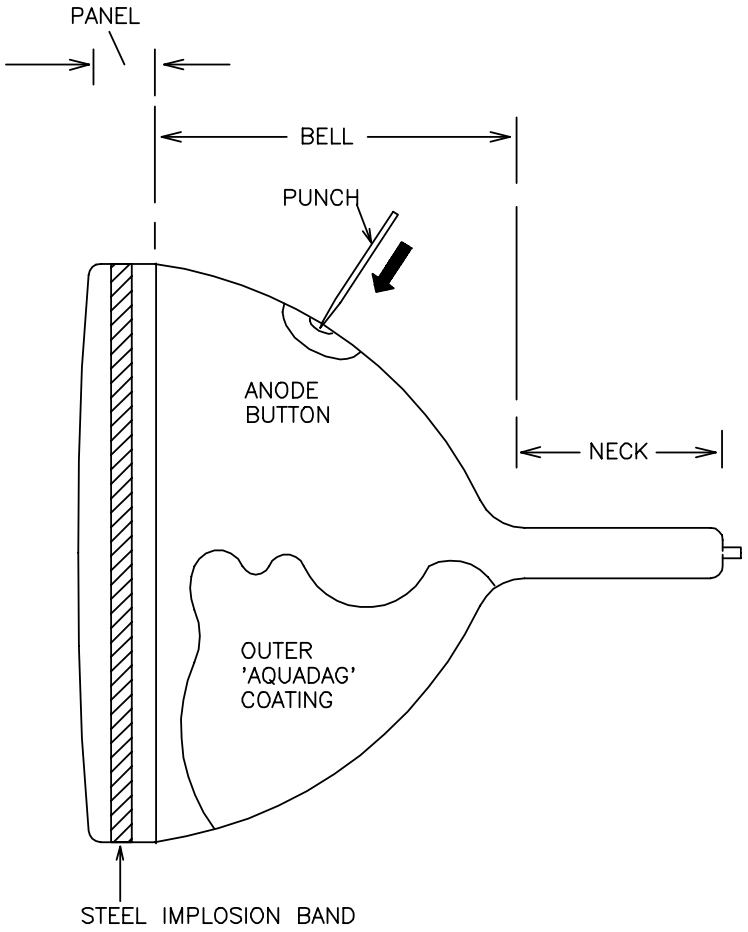
1. Put on protective goggles, gloves, apron and shoes as specified in the picture tube safety precautions.
2. Check that there is still a steel implosion protection band about the panel of the 27" or larger picture tubes. See the picture for the location. If it is not present, do not air the tube. Call for professional disposal.
3. Next, the high voltage stored by the picture tube must be discharged. The picture tube capacitor has two plates. One plate is inside, connected to the HV anode button. The other plate is outside, connected to ground. The tube's outside conductive plate is a black graphite "aquadag" coating. Use a high voltage probe (self contained)to gradually discharge the high voltage (HV) with the TV off.
4. Clip one end of a jumper wire to the chassis strap resting on the conductive black aquadag coating of the picture tube bell. Connect the other end of the jumper wire to the anode terminal. Leave the jumper there for about a minute to make sure the picture tube capacitor is completely discharged. During this time, inspect the bottom area of the picture tube to make sure the ground strap is touching the black aquadag coating.
5. Using a small screwdriver or center punch as a puncturing tool, seat it into the center of the soft lead anode button cavity (hole). The puncturing tool must be able to pass through the anode hole and not touch the anode button's outer metal rim.
6. Being careful not to hit the glass with the hammer, gently tap the tool further into the anode button. The anode is made of a soft lead amalgam that will give inward.
7. The hissing sound when the punch is wiggled out means that the tube is "aired".

B. Break the thin glass seal at the neck.

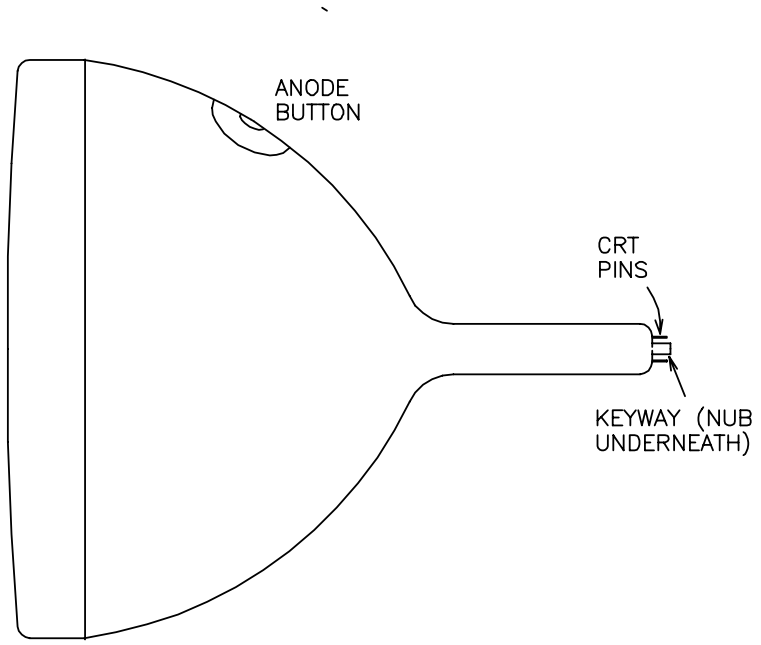
Method B for releasing the picture tube vacuum is to break the glass nub at the neck of the tube. ***Read the procedure below first:***

1. Put on protective goggles, gloves, apron and shoes as specified in the picture tube safety precautions.
2. Check that there is still a metal implosion protection band about the panel of the 27" or larger picture tubes. If the band has been removed, do not proceed with this vacuum disposal procedure.
3. There is a plastic keyway at the pins of the CRT. Remove the plastic keyway by wiggling it off. This exposes the glass nub that was sealed to maintain the vacuum.
4. With a pair of long nose pliers or diagonal cutters, break this glass nub by squeezing it to shatter the glass. The tube is "aired".

Picture Tube Safety Precautions
• Wear safety goggles even over glasses to prevent side glass entry
• Handle the picture tube with the correct size work gloves for your hands to avoid slipping
• Change to a thick long sleeve shirt to avoid exposing your skin to glass fragments
• Wear a thick rubber apron
• Wear shoes to protect your feet
• Find a partner to help move or reposition the picture tube. Your partner needs protective gear more than you do



METHOD A



METHOD B

CRT VACUUM DISPOSAL

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Overall Block Diagram

A TV set consists of several stages or blocks:

- Power Supply
- Power On/Communications
- Video Processing
- Deflection

Each stage has a purpose and is activated in sequence to properly power up the set.

Power Supply

The purpose of the power supply is to convert the incoming 120Volts AC to some of the DC voltages required to operate the set, the most important of which is the Standby +5Vdc. Standby +5Vdc is present when the set is plugged in and is used to power the Micro so it can respond to a TV power ON command from the user.

Power On/Communications

Three things occur when the power button is pressed:

- Degaussing of the picture tube
- Application of power to the Jungle IC
- Data communications

When the TV is powered ON, the Micro turns ON the degaussing circuit for 2.2 seconds. Its purpose is to pass AC through the degaussing coil that surrounds the picture tube. The AC field that is created erases residual magnetism collected by the tube's metal aperture grill.

Next the Micro IC turns the TV ON switching power from the power supply to the Y/C Jungle IC. The Jungle IC produces vertical (VD) and horizontal (HD) pulses to create the remainder of the voltages necessary for the TV to operate. This turns ON the TV (see **Deflection**).

After the TV turns ON, data and clock communications from the Micro IC are applied to the tuner and Jungle IC. The tuner is instructed to tune to the last station viewed and the Jungle IC is instructed to select the last video input used before the set was turned OFF.

The communications data and clock lines are always active when the TV is ON.

Video Processing

The Y/C Jungle IC selects a video signal from one of two external video inputs or the internal tuner video for processing. Contrast, brightness, color level and hue are also controlled in this IC. A change in level is received by the Micro IC, stored in memory, and communicated to this Y/C Jungle IC thorough the data and clock inputs. The final stage within this IC converts the information to individual red, green and blue (RGB) output voltages. The higher the voltage, the greater the intensity of that color. The three RGB voltages are applied to the video output stage.

The purpose of the video output stage is twofold:

1. To invert the signal
2. To convert the small red, green and blue input voltages to larger voltages for the picture tube drive

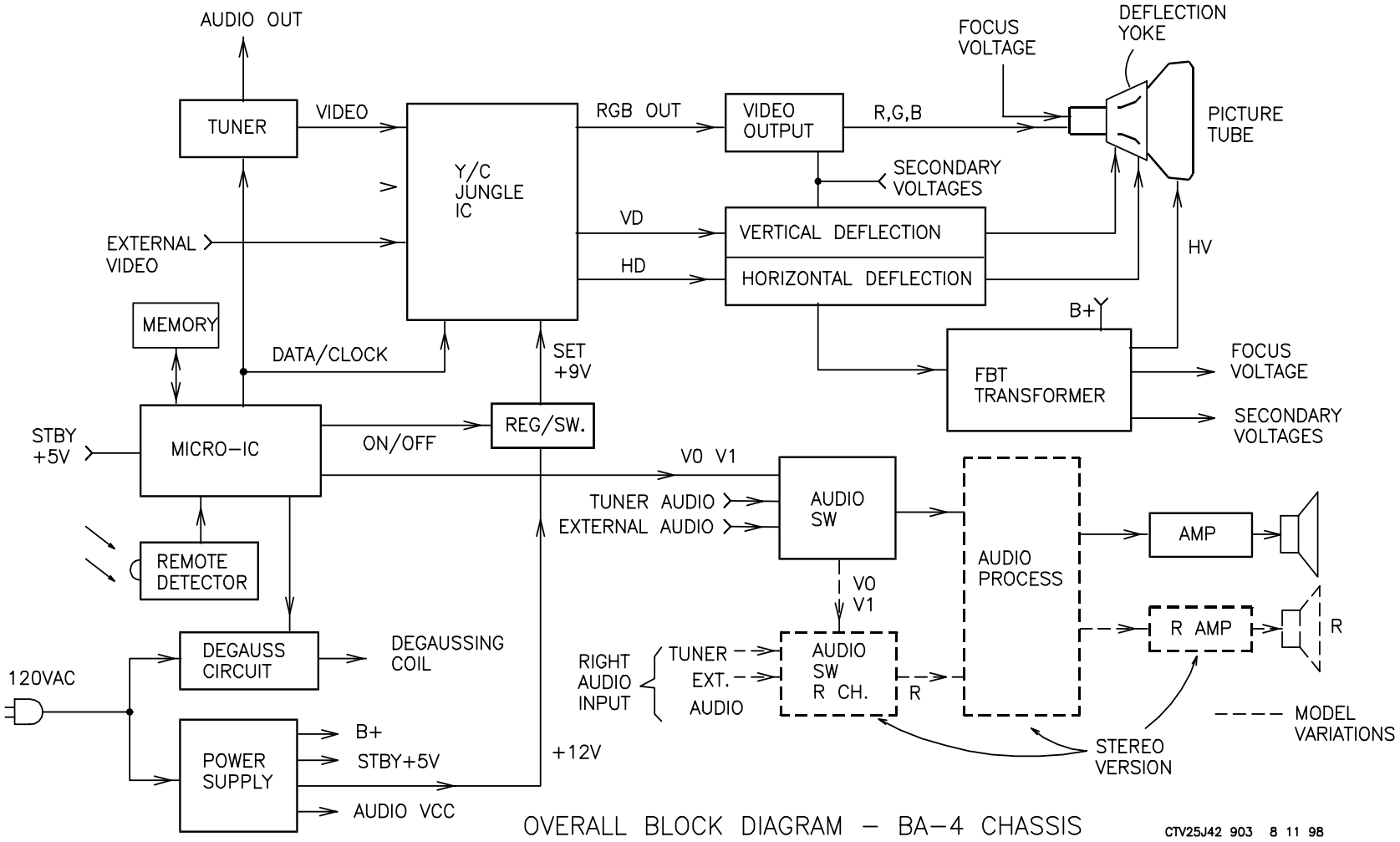
The voltage output of this video stage is applied to the picture tube cathodes. This voltage varies from 200 volts for a dark picture to zero volts for a very bright picture.

Deflection

When the Y/C Jungle IC receives power and serial data, its internal vertical and horizontal oscillators operate and output. These two VD and HD signals leave the IC to drive the external deflection amplifiers. The output of the vertical deflection stage drives the vertical deflection coil of the yoke. The purpose of the vertical yoke coil is to move or "sweep" the picture tube's electron beam downward to produce the picture.

The yoke and flyback transformer (FBT) use the output of the horizontal deflection stage. The yoke uses this drive signal in the horizontal deflection coil to sweep the electron beam from left to right and back (retrace) to produce the picture.

The flyback transformer is a low current high frequency transformer that develops the remainder of the voltages the TV set needs to operate.



OVERALL BLOCK DIAGRAM – BA–4 CHASSIS

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Power Supply Block – 20” TV & smaller

In the smaller BA-4 chassis TVs, power is applied to most of the TV stages when the set is plugged into 120Volts AC. Three stages develop and regulate the four voltages that leave the power supply:

1. The converter stage
2. The voltage output stage
3. The power output control

The Converter Stage

The purpose of the converter stage is to change the low frequency (60Hz) AC that is input to this stage into a high frequency AC signal that will output this stage. To do this, several operations take place within the converter stage:

- The 120Volts AC input is rectified into DC and filtered.
- This DC voltage powers a medium power, high frequency oscillator. An oscillator is used in this converter stage because its frequency is easily controllable and the high frequency output can pass through a small lightweight transformer. This keeps the entire TV lightweight and efficient.
- The high frequency AC output of the oscillator is applied to the next stage for multiple voltage outputs.

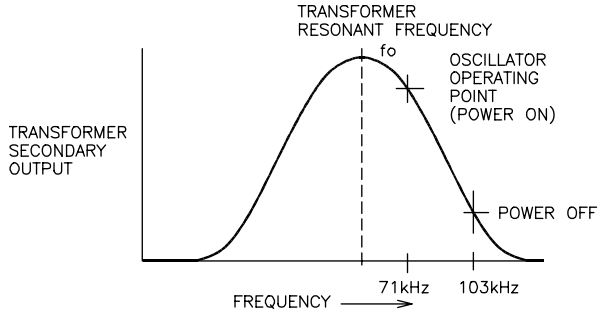
The voltage output stage

The purpose of this voltage stage is to provide multiple voltages to the TV. The oscillator signal from the converter stage is applied to a transformer in the voltage output stage. The transformer’s secondary windings are used to make the four voltages. The most important voltages are the standby +5V and the B+ voltage. In the 13” and 20” BA-4 chassis, the B+ is +116Vdc. In the 27” TV, B+ equals +135Vdc.

- The standby +5V is used to power the microcomputer.
- The (B+) is used to power the horizontal deflection and high voltage stages. Variations in the B+ voltage will cause the picture to change in width and brightness.

The power output control.

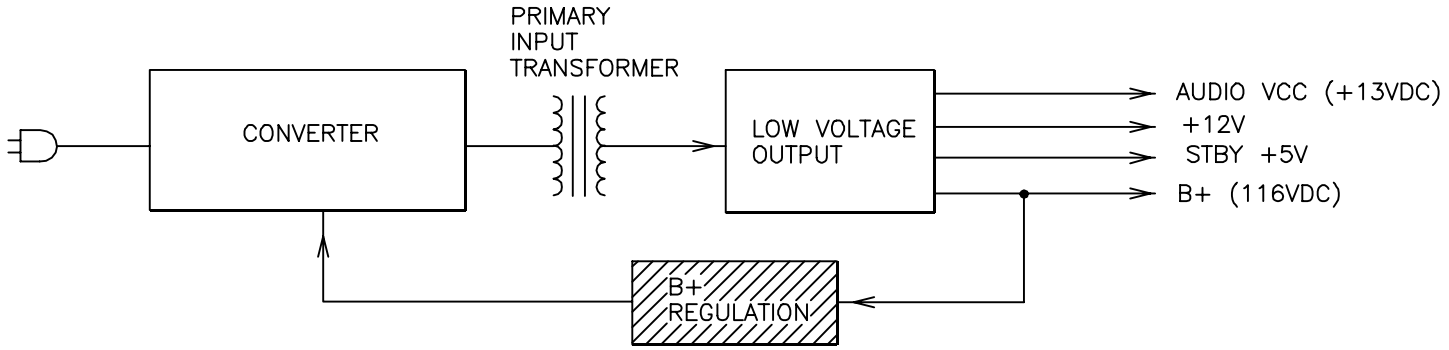
The purpose of this stage is to maintain/regulate the B+ voltage. The input to the power control stage is the B+ voltage. Variations in the B+ voltage will change the converter’s oscillator frequency.



Transformer Operation Point

Increasing the oscillator frequency results in a shift along the transformer’s resonate frequency curve. This results in a decrease in the transformer’s primary to secondary transfer efficiency. Therefore, there is reduced secondary output until the B+ has returned to normal.

Conversely, decreasing the oscillator frequency simultaneously increases the four voltages that leave the voltage output stage. In this power control circuit, the oscillator frequency stops changing when B+ has returned to +116Vdc or 135Vdc (depending upon the set size). This is how the power output control stage regulates the four voltages that leave the power supply.



POWER SUPPLY BLOCK – 20" AND SMALLER

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Converter

In the past, the word “converter” referred to a rotating machine consisting of an electric motor driving an electric generator. This system was used to change alternating current into direct current. Changing AC to DC is also the purpose of this converter, but it is done in an electronic manner.

The converter consists of two parts:

1. The Rectifier
2. The Oscillator

Rectifier

The rectifier changes the 120Volts AC into DC using bridge rectifier D601. The output of D601 is a pulsating DC waveform commonly called the ripple. The 60 Hz ripple has a crest (high point) and a trough (low point). C607 is the main filter capacitor that reduces the ripple amplitude by charging during a crest and discharging to fill a void during the trough. However, as the TV’s current demand increases, C607 cannot supply the additional current to the TV during the trough. This is why there is a higher AC ripple across the filter capacitor during a bright scene when there is a greater current demand. This is shown in the chart below:

60 Hz Ripple at Main Filter Capacitor C607	
TV Set OFF	0.8Vp-p across C607
TV Set ON – Dark screen	4Vp-p across C607
TV Set ON – Bright screen	6Vp-p across C607

Oscillator

The oscillator consists of two transistors, a main transformer, a PRT power regulator) transformer (PRT)bias and protection resistors and capacitors. When the oscillator runs, it produces a 180Vp-p square wave into the main Power Input Transformer (PIT) T603/pin 6. The two transistors (IC601) alternately turn ON and OFF to develop the square wave. The operation of the oscillator consists of three parts:

1. A quiescent state
2. When the bottom transistor is ON and the top is OFF
3. When the bottom transistor is OFF and the top is ON

The Quiescent State

The oscillator starts when DC voltage from fusible resistor R606 is applied to the oscillator stage. Two initial current paths are taken toward ground within the oscillator stage. The first current path places both transistors in the IC601 package at the threshold of conduction to establish a quiescent state. This state places 85Vdc at IC601/2’s emitter.

First Current Path to Ground		
Component	Input	Output
R606		
R608 & R609	R608	R609
IC601-2	Base	Emitter
IC601-2	Collector	Emitter
R611 & R610	R611	R610
IC602-1	Base	Emitter / Ground
IC602-1	Collector	Emitter / Ground

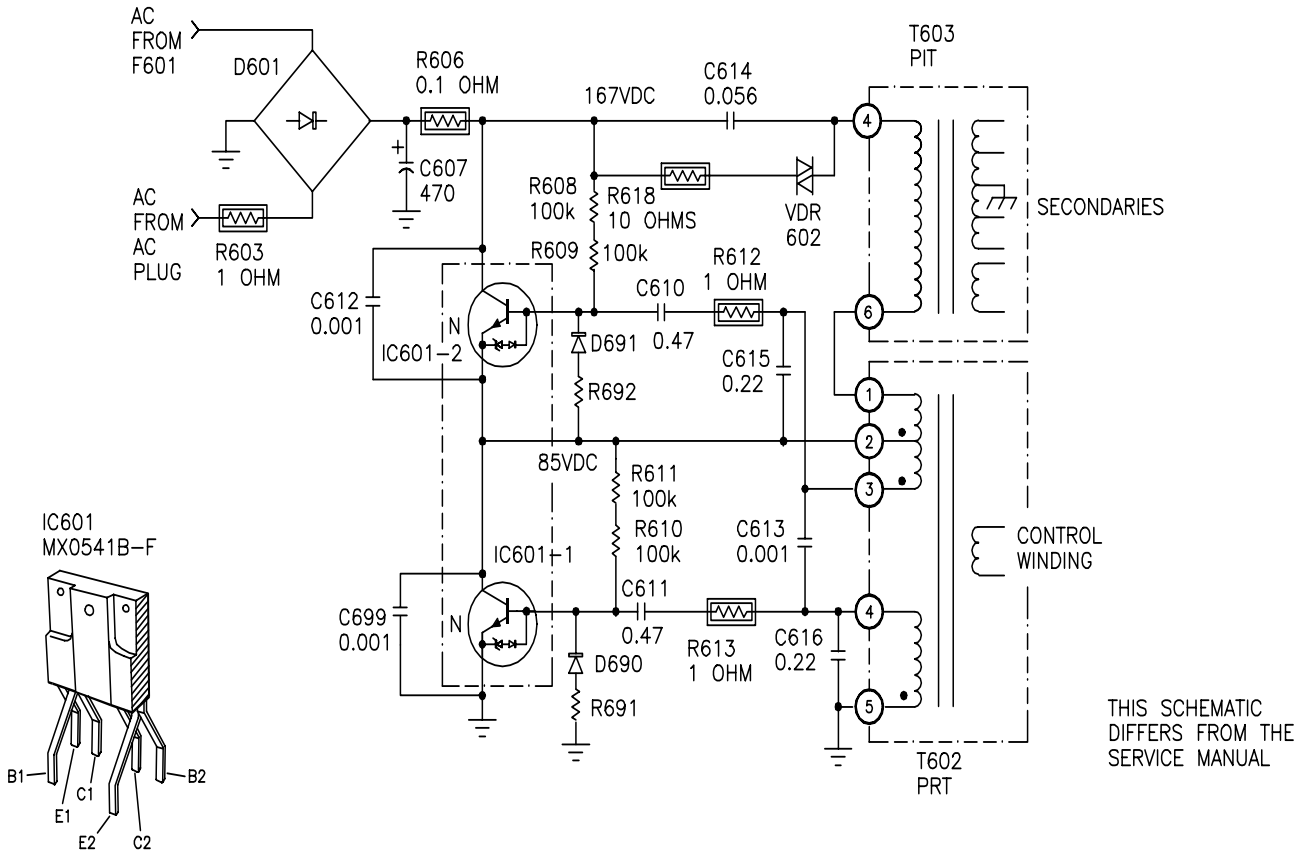
Resistors R608, R609, R611 and R610 form a voltage divider string from the +167Vdc supply to ground. The base – emitter junction of IC601/2 connects resistors R609 and R611. R610 is connected to ground by the base – emitter junction of IC601/1.

The voltage at the junction of R609 and R611 is approximately half the supply voltage because the resistors in the voltage divider string are the same value. Therefore, before oscillation begins, there are 167Volts/2 = 83.5Vdc at IC601/1’s collector. At this time, the TV set consumes 40ma AC (C614 removed to stop oscillation).

Bottom Transistor IC601-1 Turns ON

The second current path turns OFF transistor IC601-2 and turns ON transistor IC601/1, beginning the oscillator operation. This path passes through several parts to ground:

Second Current Path to Ground		
Component	Input	Output
R606		
C614		
T603 PIT	Pin 4	Pin 6
T602 PRT	Pin 1	Pin 2
R611 & R610	R611	R610
IC601-1	Base	Emitter / Ground
IC601-1	Collector	Emitter / Ground



CONVERTER

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A magnetic field is created when current flows through pins 1-2 of PRT transformer T602. This induces a negative voltage that outputs the transformer at T602/pin 3. This negative voltage is applied to the base of IC601-2, turning it OFF.

At the same time, a positive induced voltage from T602/pin 4 is applied to the base of IC601-1. This voltage is held there by capacitor C616 and coupled to the base via C611. The positive voltage drives IC601-1 into saturation (ON). The voltage at the collector of IC601-1 becomes zero by transistor action. This zero volts also appears at T603/pin 6 because the inductance of T602 is small (few windings).

Because C614 initially acts like a momentary short, the full +167 supply voltage is applied to T603's primary transformer windings (pins 4-6). T603's rising magnetic field is coupled into the secondary windings.

Top Transistor IC601-2 Turns ON

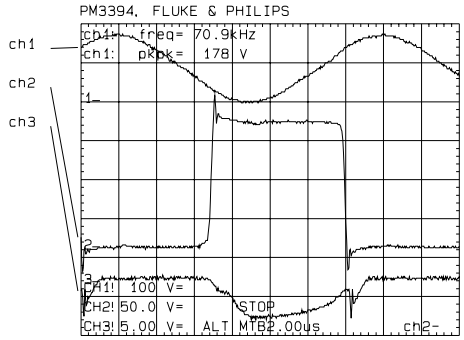
The conduction of the transistors in the IC601 package alternate when the magnetic field in T603 collapses. Eventually, C616's charge leaks off so IC601-1 can no longer be held in conduction. At this time current stops flowing through IC601-1 and PIT T603's primary winding. The magnetic field that is built up in the primary winding of T603 now collapses and current through the primary winding of T603 flows in the opposite direction. During the collapsing magnetic field, current takes this path through IC601-2:

Collapsing Magnetic Field Current Path		
Component	Input	Output
T603/pin 4		
C614		
R608 & R609	R608	R609
IC601-2	base	Emitter
IC601-2	collector	Emitter
T602	pin 2	Pin 1
T603/pin 6		

Both IC601 transistors receive a change in base bias. While current is flowing through T602/pins 2-1, a positive voltage is induced and output T6502/pin 3. This is coupled into the base of IC601-2, turning it ON. At the same time, a negative voltage is induced and output T602/pin 4. This turns IC601-1 OFF. As a result of IC601-2's conduction, its emitter rises to 167Vdc.

When the collapsing magnetic field in T603 has depleted its energy, the cycle repeats, starting with the charging of C614. The result is a square wave at the junction of the two IC601 transistors when they alternately turn ON and OFF.

The following waveform shows the oscillator's square wave output (channel 2) at IC601. It is shown with IC601-1 base bias (channel 3) and the sine wave at the junction of transformer T603 and C614 (channel 1).



Oscillator Stage. TV = ON, 120Vac input.

Channel 1 – T603/pin 4; 50V/div.

Channel 2 – IC601-1 Collector; 50V/div.

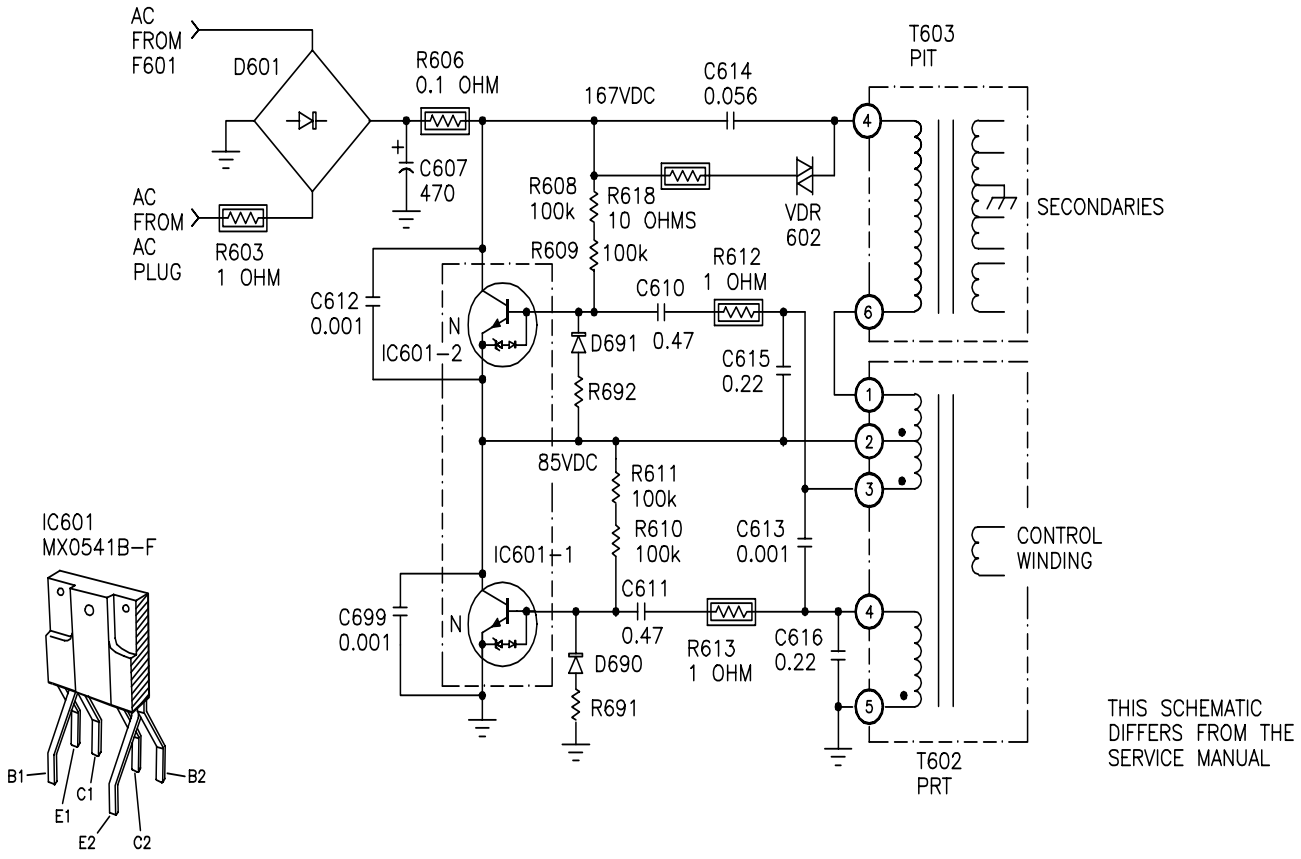
Channel 3 – IC601-1 Base; 5V/div.

Time base = 2usec/div.

Oscillator Stage Protection

Protection 1 – VDR602

All of the TV's power comes through C614 and T603. A bright scene accompanied by a surge in AC line can pass more current through C614 than normal. More current means there would be a greater voltage drop across C614. If the capacitor's maximum voltage is exceeded, it will short and damage the transformer. VDR602 is placed across C614 for its protection. VDR602 is a Voltage Dependant Resistor that only shows low resistance when there is a high voltage across it. When good, it measures like a small capacitor.



CONVERTER

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Protection 2 – D690 & D691

The oscillator transistors (IC601) are protected from a base to emitter failure. A transistor's base to emitter junction can be punctured (open) or shorted. By applying an 8-10 volt reverse (b-e) bias voltage from a collapsing magnet field to this junction, the transistor will short. C615, C616 and C613 prevent sharp (high voltage) spikes from leaving the transformer. Diodes D690 and D691 prevent the transistor's base to emitter junction from being reversed.

Protection 3 – C612 & C699

A transistor's collector to emitter junction can be shorted if the maximum voltage across these terminals is exceeded (Vce). Although the typical maximum voltage for these transistors is 600volts, it can still be exceeded when lightning brings in a much higher voltage. The voltage spikes from a non-direct lightning hit may be high in voltage, but low in current (small pulse width). They are bypassed to ground with C612 and C699. If a very high current spike shorted IC601-2 from collector to base, current would also have flowed through C610 and R612 and they should be replaced.

IC601 Protection		
Protection from internal spikes causing immediate failure.	D690/D691 – prevents IC601's E-B junction from reverse bias damage	C615/C616/C613 – rounds off sharp spikes from rising and collapsing magnetic fields.
Protection from external spikes (lightning).	C612/C699 –high voltage low current spikes are circumvented by this capacitor. This reduces the voltage to IC601 so the transistor's C-E breakdown voltage specification is not exceeded.	
Protection - Thermal	R606 (fusible resistor).	

Oscillator Frequency

The oscillator frequency is predominately a function of T603 inductance and C614 capacitance, forming a sine wave at the junction. Since the inductance of T603 is changed with a load, the frequency of the oscillator will be different when the set is turned ON.

Oscillator Characteristics		
Resonate parts:	L = T603 (uH)	C = C610, C611, C614, C615, C616
Frequency:	104kHz. TV OFF (no load)	71.5kHz. TV ON

Oscillator Testing

After replacing parts in this stage, check the following with an ohmmeter before gradually applying power:

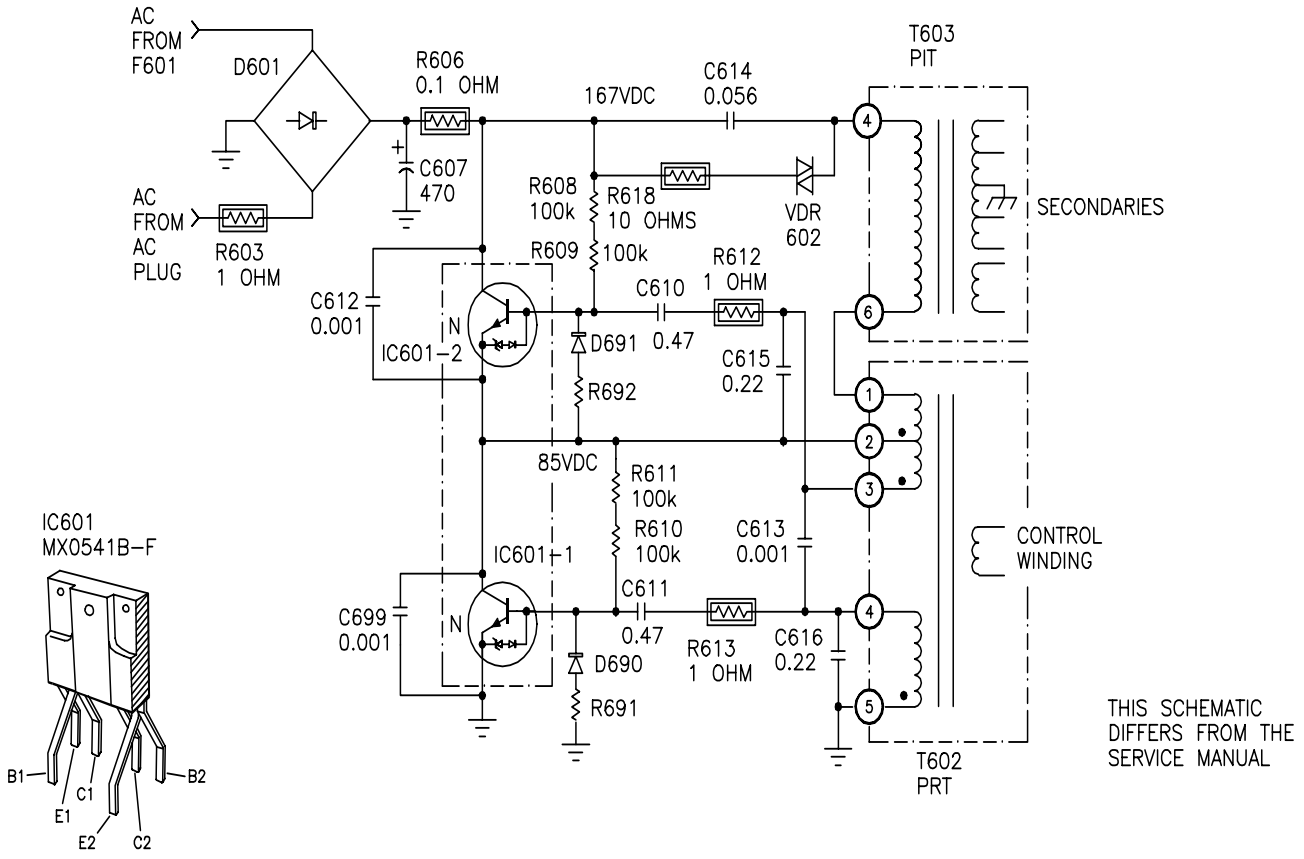
- Shorts in T603 secondary winding loads (secondaries). Check zener diode D610 first (see Converter Voltage Output diagram below)
- Shorts in a flyback secondary winding loads

Testing Procedure Steps:

1. Plug the set into an isolated variable AC transformer (must contain an AC ammeter and voltmeter) and set to zero volts AC.
2. Unplug the degaussing coil so the AC ammeter will only show the TV current consumption.
3. Gradually increase the AC voltage to the TV while observing the following:

- The AC current on the variable AC transformer
- The oscillator supply voltage (DC) at fusible resistor R606
- The DC voltage at the collector of the bottom transistor IC601-1

4. Gradually increase the AC voltage. The DC voltage at the collector of IC601-1 will always be half that of the oscillator supply voltage at R606 if the oscillator is OK. This is true at any time, even when the AC voltage is being increased. The oscillator will start when there is about 5-6Vdc at R606.



CONVERTER

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What to Expect When Increasing the AC Voltage to the TV	
Observe:	Normal on a 20" BA-4 chassis TV
AC Current (degaussing coil unplugged)	Current will rise to 1 amp at about 12Volts AC, then drop down to 0.34Amps
Oscillator's DC supply voltage at R606	Will increase proportional to the AC voltage being increased.
Collector of IC601-1	Must be half the DC voltage measured at R606. If not, a part is still defective.

Normal Testing Results

Below is a chart that shows the converter/TV operation as AC is increased slowly to the TV that is OFF. The Degaussing coil is unplugged during this test.

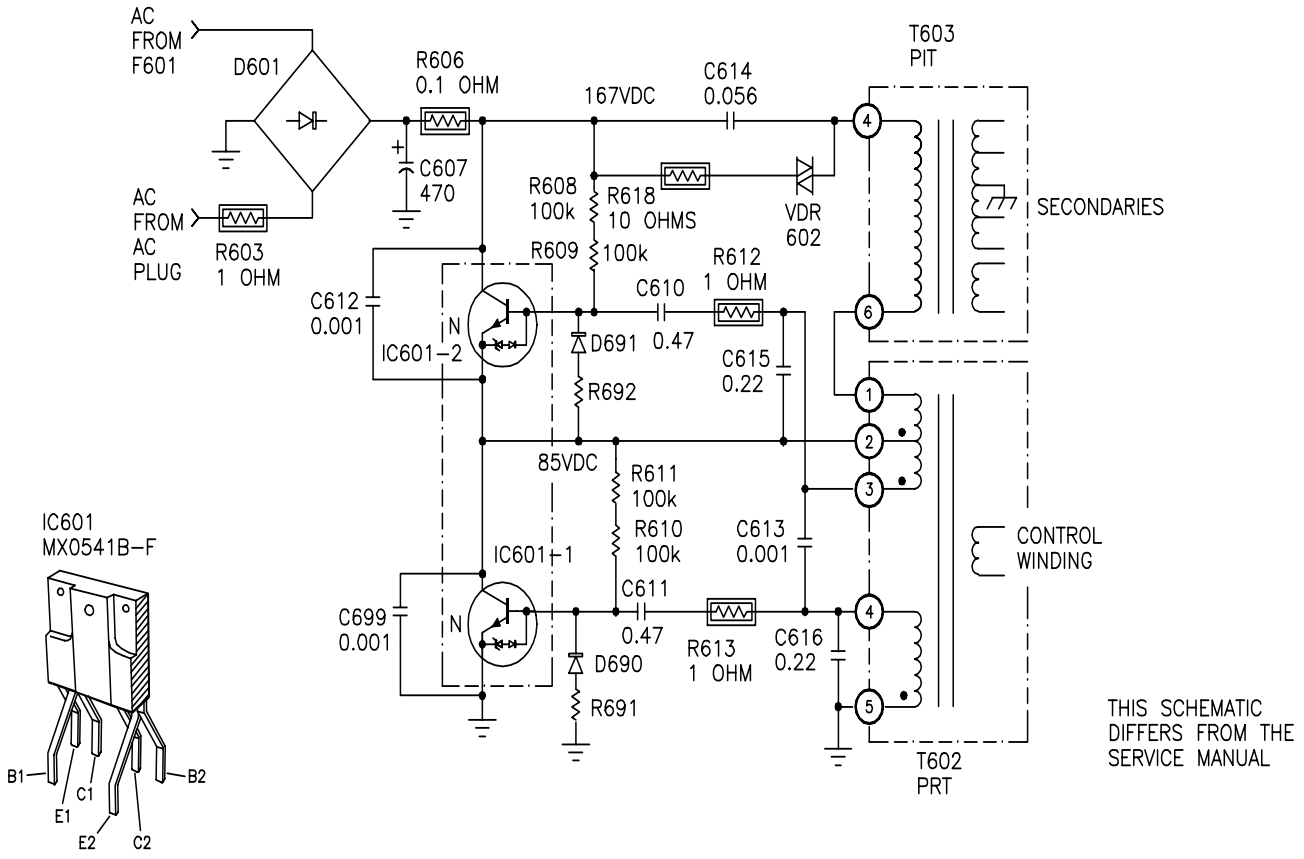
In the 27" BA-4 chassis, the converter can be tested by temporarily jumping the TV's ON/OFF relay contacts and removing the load by unsoldering a series inductor L504. Do not disconnect the B+ regulating stage (IC603, DM-58) or the TV will draw an abnormally high current as the AC voltage is increased.

Increasing Voltages with TV OFF – Model KV20M40				
		Converter IC601-2/E		
AC	DC at R606	Vp-p	Freq.	B+
7 Vac	8 Vdc	20 Vp-p	55kHz	22Vdc
11 Vac	11 Vdc	28 Vp-p (w spikes)	49kHz	108Vdc
22 Vac	25 Vdc	35 Vp-p	51kHz	116Vdc
40 Vac	50 Vdc	60 Vp-p	54kHz	116Vdc
75 Vac	100 Vdc	100 Vp-p	61kHz	116Vdc
110 Vac	150 Vdc	150 Vp-p	78.5kHz	116Vdc
120 Vac	166 Vdc	170 Vp-p	104kHz	116Vdc

When beginning to increase the AC voltage to the set under test, the AC current will increase sharply until the B+ reaches the correct voltage for that set (116Vdc or 135Vdc) and then drops gradually as AC voltage is increased. The degaussing coil is unplugged during this test.

Peak AC Current Consumption		
Model	AC Voltage	AC Current
KV20M40	12Vac	0.8 Amps
KV27S45	11Vac	1.3 Amps

Above 12Vac, the B+ has reached its maximum and the regulation stage changes the converter frequency to supply sufficient TV current to maintain a steady B+ voltage. As the input AC is being increased toward 120Vac, the current continues to drop toward the normal operating level. This TV power supply can run unloaded, but the regulation circuit must remain intact or the unit will damage the converter IC601 and blow a fuse.



CONVERTER

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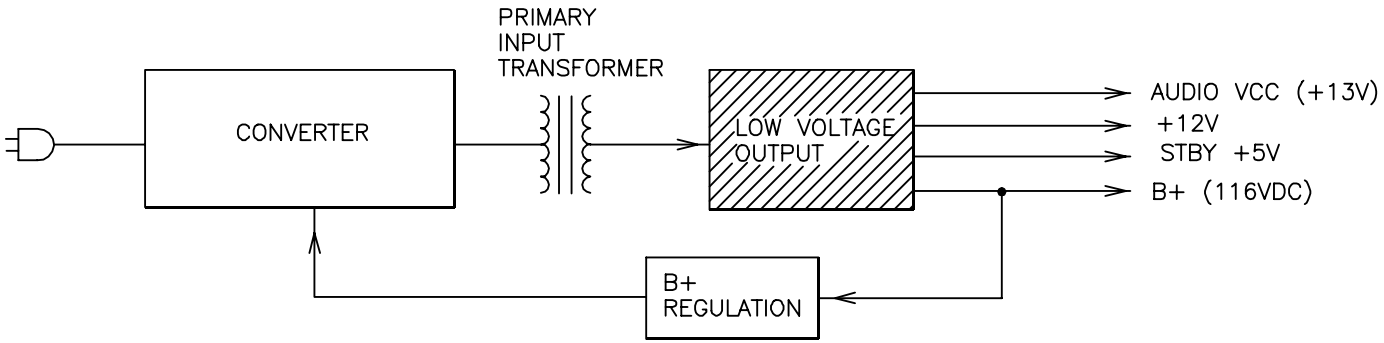
NOTES



POWER SUPPLY BLOCK – 20" AND SMALLER

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Converter Voltage Outputs

Once the converter oscillator is running, current is induced into the secondary windings to power the set. Three voltages are derived from this converter power supply:

- Audio Vcc = +13Vdc
- B+
- +12 Vdc Source

Audio Vcc

This fused +13Vdc is applied to power amplifier ICs. The 27" TV uses one stereo power amplifier IC because all the 27" TVs are stereo.

Audio Vcc Destination		
TV Type	Audio Output Package 1	Audio Output Package 2
13" and 20" Monaural	IC400	
13" and 20" Stereo	IC400 (right)	IC401 (left)
27"	IC401 (stereo pkg)	

B+

Two different T603 Power Input Transformers are used:

Power Input Transformers (USA models)		
TV Type	T603 part number	B+ Voltage Output
13" & 20"	1-431-674-11	115-116Vdc
27"	1-431-837-11	135Vdc

D610 is a 150Vdc-zener diode placed on the B+ line to guard against excessive B+ voltage. D610 will short to prevent the horizontal output transistor and transformer load from seeing the excessive B+ voltage.

Unfortunately, a prolonged short on the B+ line will load down the converter stage. In the converter stage, IC601 will short (fail) trying to supply current to maintain the B+ voltage. Therefore if you find a shorted converter IC601, check the D610 zener as well. After parts replacement, test the converter stage by following the steps outlined in the Converter section of this book.

+12 Vdc Source

+12Vdc is applied to several stages at plug in	
Stage	Purpose
Q604, Q605, switched +9V regulator.	Applies +9Vdc to the Jungle IC to power ON the TV.
RY601, Degaussing Relay.	Permits the degaussing relay to operate at plug in (TV power is OFF).
Q203, Audio mute.	Insures audio mute at power OFF.
IC002, Standby +5Volt regulator.	Powers and resets Micro IC001. See below.

IC001 Vcc Power

At plug in, Micro IC001 is powered and reset using IC002. When +12Vdc is applied to IC002/pin 4, a regulated +5Vdc leaves pin 5. This is the Standby +5Vdc used to power the Micro IC001, Memory IC003, and the remote infrared receiver IC004.

IC001 Reset

IC001 also needs to be reset when standby power is applied. IC001/pin 30 is connected to IC002/pin 2. IC002 performs the reset operation by keeping its pin 2 LOW for 60msec at AC plug in. After 60 msec., reset ends when this line goes HIGH. The HIGH permits the Micro to operate beginning with memory data retrieval.

This reset operation is shown in the following waveforms. The top channel 1 is the standby +5Vdc at plug in. The middle waveform is the reset signal from IC002 and the bottom waveform (channel 3) is the reset signal at IC001/pin 30 after a pi-filter network. The pi-filter network insures no voltage spikes pass into the Micro.

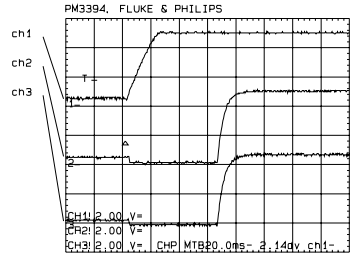
Plug Into 120Volts AC

Channel 1 – IC002/pin 5; 2V/div.

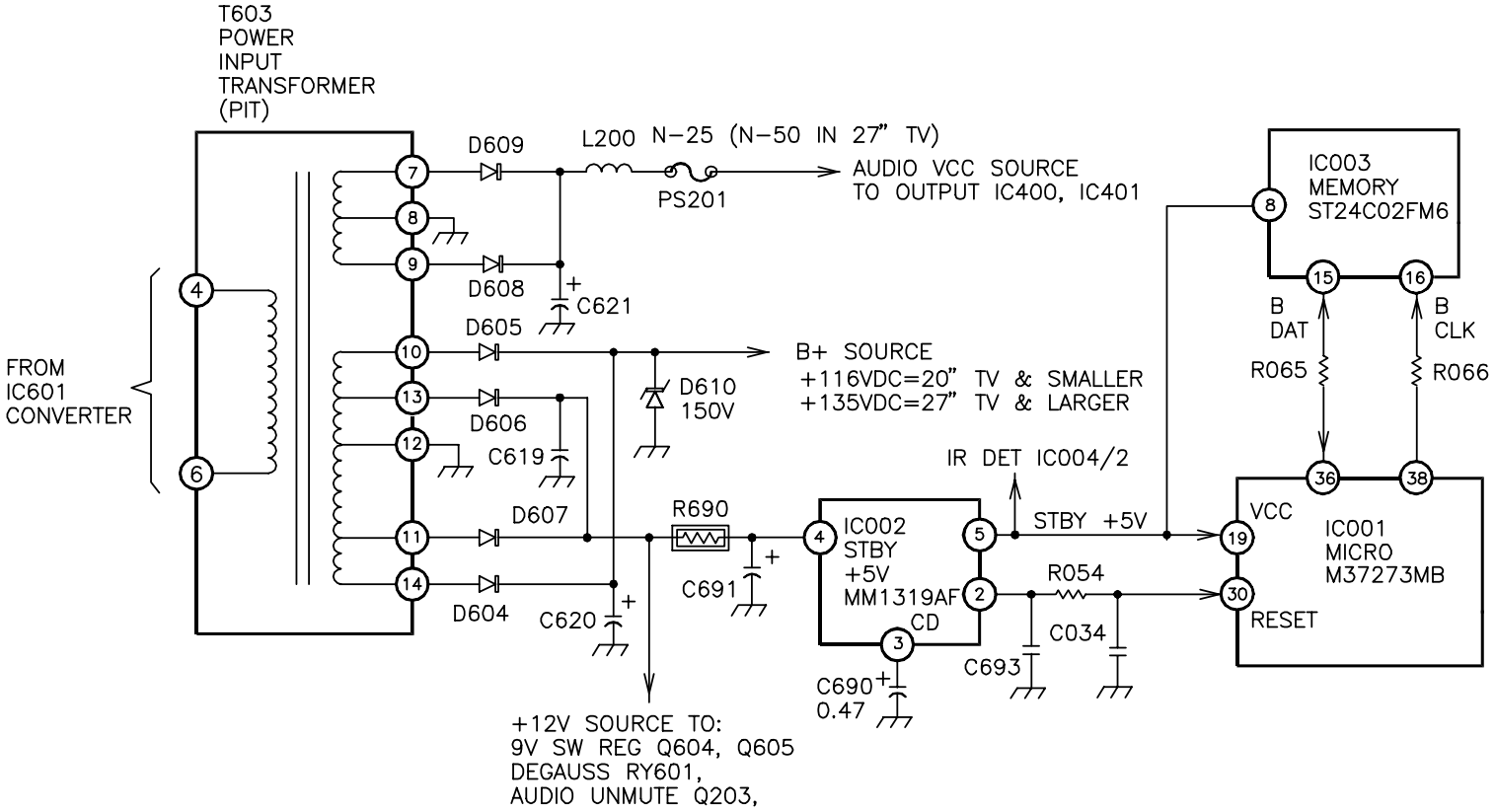
Channel 2 – IC002/pin 2; 2V/div.

Channel 3 – IC001/pin 30; 2V/div.

Time Base = 20msec/div.



Capacitor C690 connected to IC002/pin 3 is used to extend the reset time to 60msec. Without it, the reset time is only 20msec.



CONVERTER VOLTAGE OUTPUTS

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IC001 Memory Data Retrieval

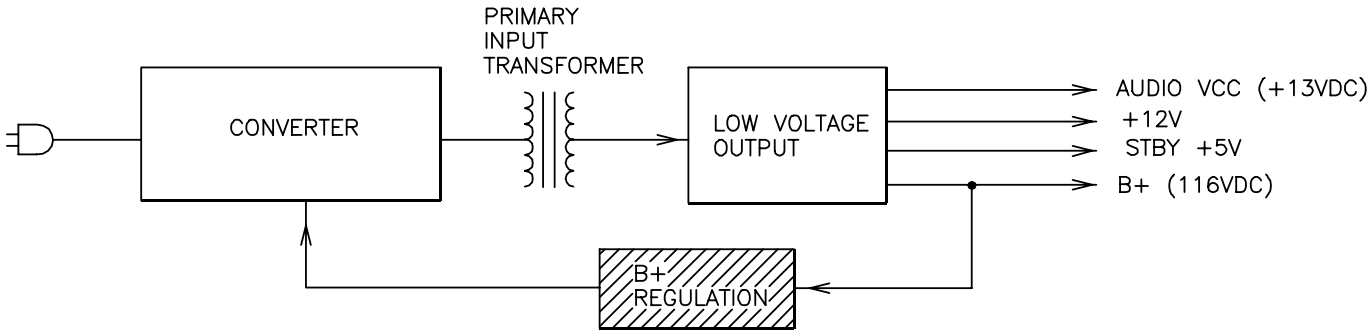
After reset, one of IC001's first programs is to retrieve data from the external EEProm memory IC003. Data and clock are output IC001/pins 36 and 38 to request a reading of all the memory information. The memory information is serially output IC003/pin 5 and stored in Micro IC001's resident memory (internal RAM). This memory information contains:

- The user's picture and sound preferences;
- The last active TV station information; and
- The TV operating parameters (height, width, linearity, OSD position, etc).

Each time the user's preferences and channel are changed, the Micro IC001 loads these changes into memory IC003.

Micro IC001 and Memory IC003 communications occur during these times:

Micro – Memory Communications		
When	Direction	Purpose
Plug In	To Micro	Load user and operating parameters into working RAM in IC001.
User command change	To Memory	Each time the user changes a preference (like volume, or channel number).



POWER SUPPLY BLOCK – 20" AND SMALLER

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B+ Regulation – 13” & 20” TV

The primary purpose of this stage is to regulate the B+ voltage that outputs from power input transformer T603.

Additional circuits are connected to this regulating stage to:

- Fine adjust the B+ voltage
- Reduce T603 output at power OFF
- Reduce picture blooming

Regulation

Power Input Transformer T603 has several secondaries that output three different voltages for the TV to operate. For regulation, the B+ output is used as a sample and the +12V output is used in the control.

The B+ voltage is sampled and used to control the converter oscillator frequency. Changing the frequency of the oscillator in turn changes all the outputs from the T603 transformer, including the B+. This regulation method allows the B+ voltage from T603’s secondary winding to be maintained at a constant level.

Resistor R699 samples the B+ voltage from PIT T603 and applies it to a voltage divider (R626 and R625). This reduced B+ voltage is applied to power control/error regulator IC602/pin 1. The IC602/pin 3 output is inverted from the input so if the B+ voltage increased, IC602/pin 3’s output decreases. Therefore IC602 is a voltage error regulator.

Error regulator IC602 is used to control the converter oscillator frequency. IC602 changes the current through PRT transformer T602’s control winding at pins 7-8. Current thorough the control winding reduces the effective inductance of this special transformer. When the inductance of a resonate circuit decreases, its oscillator frequency increases. Therefore, current through the control winding of PRT transformer T602 sets the converter frequency.

The secondary output of the Power Input Transformer T603 is determined by the converter frequency input to its primary. The converter oscillator develops a symmetrical square. This waveform is applied to a tank circuit consisting of C614 and T603 which is resonate at about 60kHz in this TV set.

The output at T603 is a bell shaped curve shown in the diagram below. The oscillator frequency input to this tank circuit is above resonance at point A. Therefore the output of T603 is not at maximum. By changing the frequency of the oscillator, the secondary power output of the PIT T603 will supply sufficient current to maintain the same B+ voltage despite a changing load. In summary, variations in load current will occur with changing scene brightness. IC602 will cause a change to the converter frequency to meet the current demand while maintaining a constant B+ voltage.

The table below shows that there are changes to the converter frequency as the current demand changes.

Converter Frequency Changes to Meet TV Current Demands			
TV	Control Voltage IC602/pin 3	Converter Frequency	B+ Voltage
White screen	10.4Vdc	71.55kHz	113.8Vdc
Black screen	10.2Vdc	71.63 kHz	116.7Vdc
TV OFF	8.9Vdc	103 kHz	116Vdc

Measured using a Sony model KV20M40 TV connected to 120Vac.

Additional circuits

Additional circuits are connected to this regulating stage in order to:

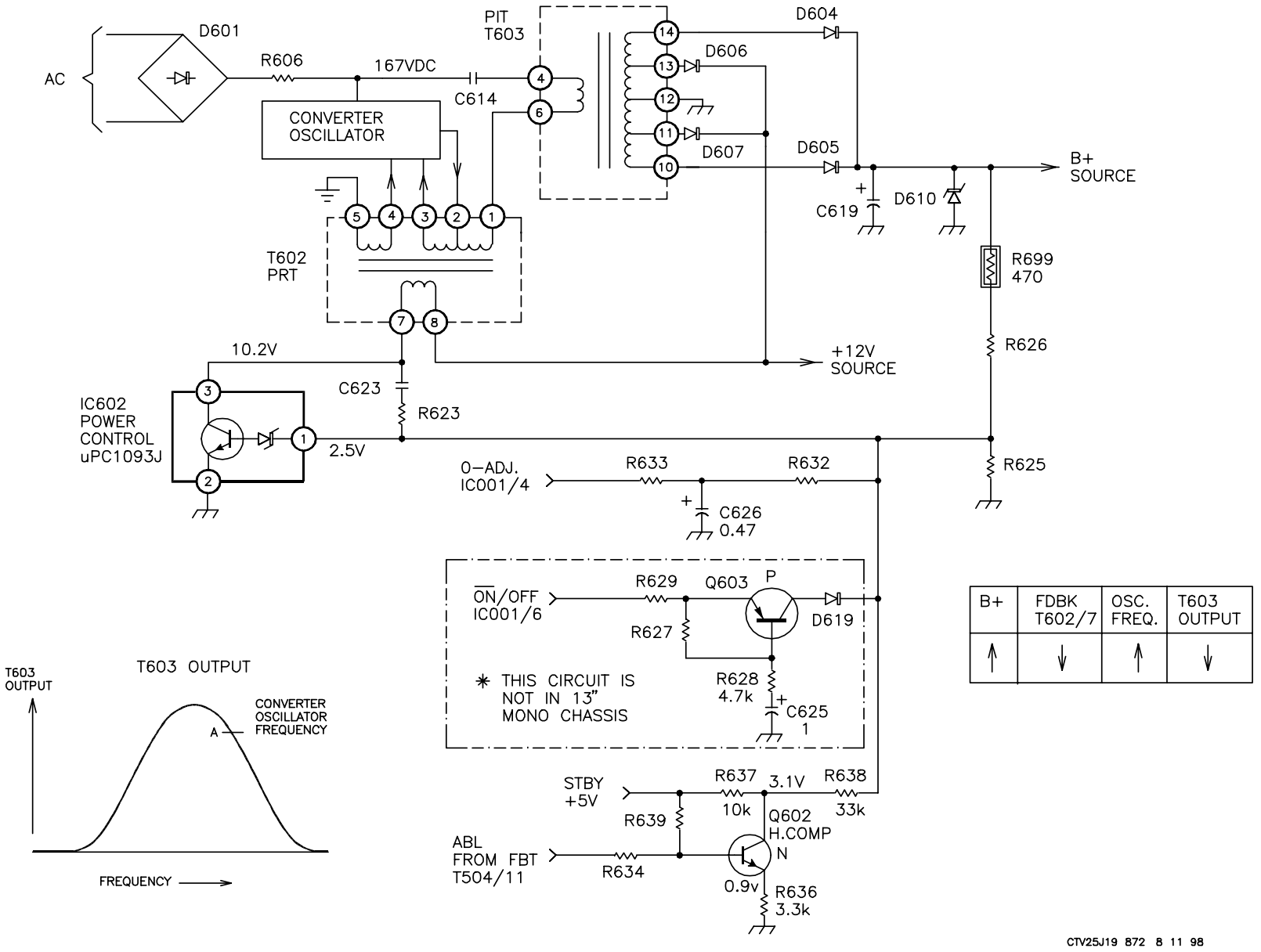
- Permit fine adjustment to the B+ voltage via the service mode
- Immediately reduce T603 output at power OFF
- Reduce picture blooming

Fine adjust the B+ voltage

Micro IC001 outputs an analog voltage from information stored in memory to fine tune the B+. This voltage is output IC001/pin 4 at turn ON and is coupled to the error regulator IC602/pin 1 stage using R633 and R632. This memory-stored information can be accessed via the TV’s service mode. Removing R632 causes the B+ voltage to regulate at +110Vdc instead of +116Vdc.

T603 output reduction at power OFF

When the TV set is turned OFF, the load disappears. This sudden change causes the B+ to rise instantaneously. To prevent this increase, Q603 receives a HIGH at the same time the TV is turned OFF. Current flows



B+ REGULATION

through its emitter-base junction, R628 and C625, to ground. Q603 turns ON increasing the voltage at error regulator IC602/pin 1. This results in a decrease in T603 output to offset the no load condition at power OFF.

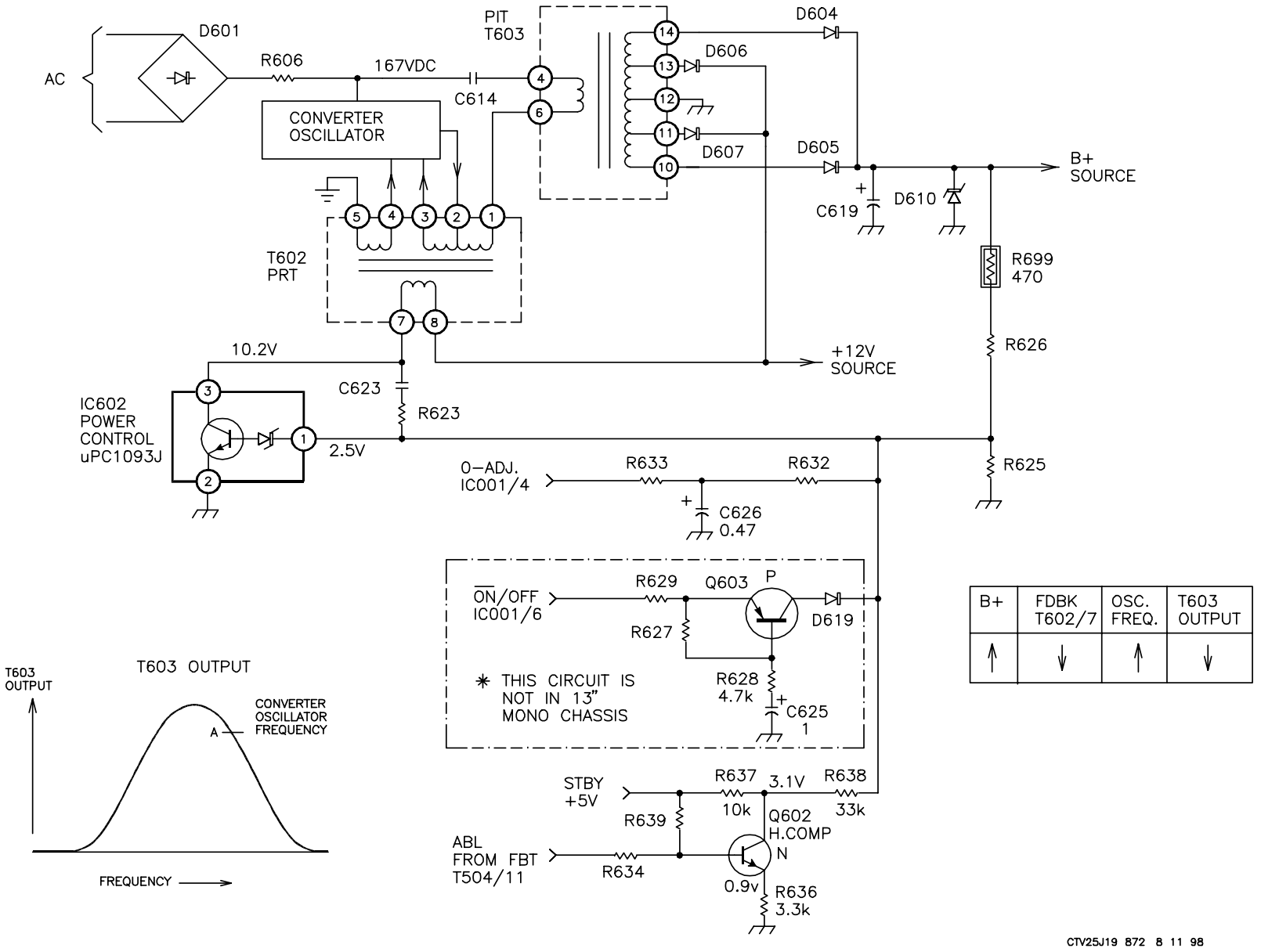
Reduce picture blooming

Picture blooming can occur when a bright scene is called for. This scene causes the TV to draw the largest amount of power from the power supply at once. When the power supply is delivering the maximum amount of current, it is functioning at the very top of the bell curve in the non-linear region. At this operating point, the B+ regulation does not exist. The picture may stretch disproportionately (blooming) as the B+ fluctuates.

To avoid this, Q602 monitors the ABL voltage from the flyback transformer secondary. A bright scene causes this ABL voltage to decrease. Q602 inverts this change and a positive going change is applied to the error regulator IC602/pin 1. This results in a reduction of T603 output, shifting the operating point away from the top of the bell curve. This reestablishes regulation at very bright scene levels. Picture blooming as a result of no regulation is reduced.

If Q602 failed, it would cause a negligible effect on the width of the picture. This can be understood by observing that there are only small changes to the B+ voltage and converter frequency when Q602 is defective.

Results of Q602 Failure		
Q602	Converter Frequency	B+ Voltage
Shorted c-e	68.8kHz	119Vdc
Normal	71kHz	116Vdc
Open c-e	72.5kHz	111Vdc



B+ REGULATION

Power Supply Block – 27” Models

13” and 20” Sony Electronics BA-4 chassis

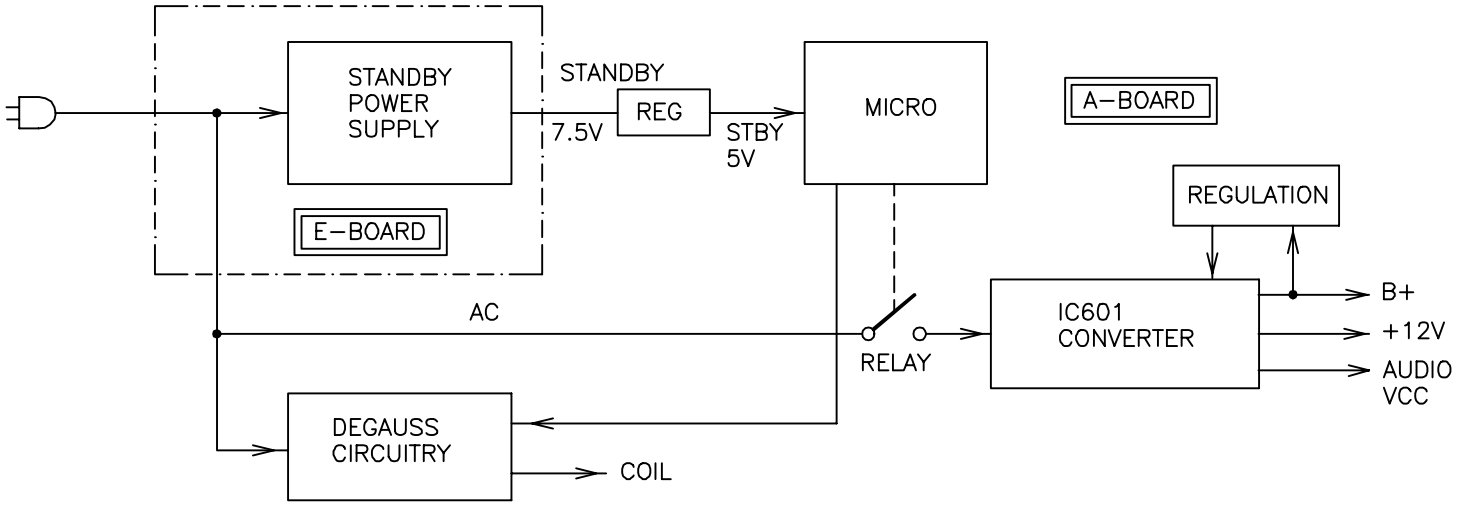
In the 13” and 20” Sony Electronics BA-4 chassis TV sets, the converter oscillator runs when the set is plugged in. Only the “Set +9V” is switched ON to turn ON the TV.

27” Sony Electronics BA-4 chassis

The 27” model of the BA-4 chassis is a bit more conventional. Only the standby power supply is active when this TV is plugged in. This standby +7.5 is regulated down to standby +5V. Standby +5 voltage is used to power the Micro and Infrared receiver so it can respond to a power ON command from the user.

When the Micro receives a power ON command, first the degaussing circuitry becomes active. While this circuit operates, the power relay is energized. This relay delivers AC power to the converter stage which outputs B+, +12Vdc, and audio Vcc (+13Vdc) to power up the TV.

This standby power supply is new to the consumer TV line. It contains a FET based oscillator that can operate over a wide range of input voltages.



POWER SUPPLY BLOCK – 27" MODELS & LARGER

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Standby Power Supply

This standby power supply is new to the consumer TV line. It contains a FET based oscillator circuit that can operate over a wide range of input voltages, but it must have a load.

Standby Oscillator Normal Operating Conditions		
TV	7.5Vdc Load current	Frequency @ Q5001/D
ON	130 ma	42kHz
OFF	30 ma	74kHz
Standby 7.5Vdc output not loaded.	0 ma (load unplugged)	Dampened ringing at 79kHz.

There are several stages that make up this oscillator circuit:

- Basic oscillator
- Voltage regulator
- Current limiter
- Additional components

Basic Oscillator

For this oscillator to work, FET Q5001 is turned ON and OFF with the aid of the standby transformer T5001.

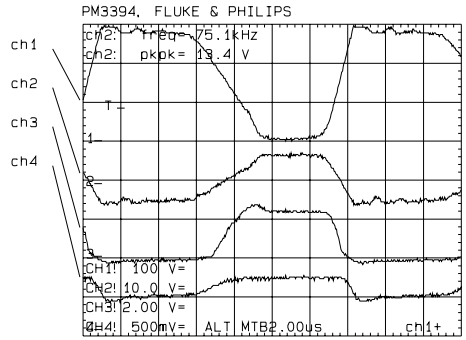
FET Q5001 - ON

FET Q5001 is turned ON when a positive voltage appears at its gate. The voltage comes from fusible resistor R5001 and passes through T5001/ pins 1-3 and R5003 to arrive at Q5001's gate. As the gate voltage increases, the FET drain to source resistance decreases. Q5001's current flows from T5001/pin 1-3 through the drain to source of Q5001 thorough R5011 to ground:

Initial Current Path to Ground		
	Input	Output
T5001 SBT	Pin 1	Pin 3
Q5001	Drain	Source
R5011		Ground

Current flowing thorough transformer SBT T5001/pins 1-3 induces voltages into the other windings. A positive voltage leaves T5001/pin 4, through C5004 to Q5001's gate. This positive voltage keeps the FET ON. This second turn ON voltage is necessary because while Q5001 is in conduction, the original turn ON voltage from R5003 has dropped to zero.

This waveform shows the gradual conduction of Q5001 (drain voltage decreasing in channel 1) as its gate voltage increases (channel 3) to about 2.3Vdc.



Model KV27S45 TV is OFF.

Channel 1 - Q5001/Drain; 100V/div

Channel 2 – T5001/pin 4; 10V/div.

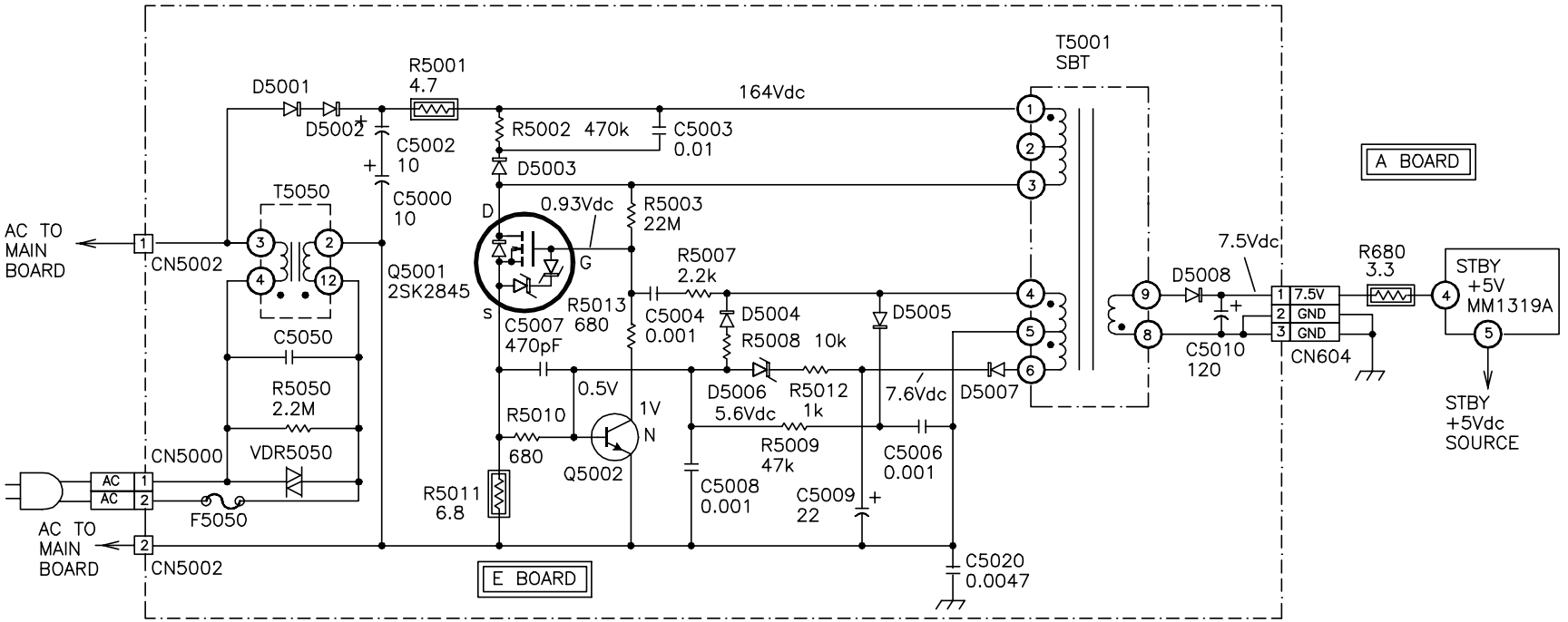
Channel 3 - Q5002/collector; 2V/div.

Channel 4 - Q5002/base; 0.5V/div.

Time base = 2usec/div.

FET Q5001 – OFF

At the beginning of the ½ cycle, the positive voltage at Q5001's gate decays. This is because C5004's charge has leaked off. The reduced Q5001's gate voltage begins to turn Q5001 OFF so its drain voltage rises.



STANDBY POWER SUPPLY

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When FET Q5001 is turned OFF, its drain voltage rises above the 164Vdc-supply voltage (to about +300Vdc). This is because magnetic energy stored in the SBT T5001 winding collapses. The reversed current flow applies a positive voltage to charge C5003 via D5003:

Current Path from T5001's Collapsing Magnetic Field		
Part	Input	Output
T5001		Pin 3
D5003	Anode	Cathode
C5003		
T5001	Pin 1	

T5001's collapsing magnetic field induces a LOW voltage that is output pin 4 to Q5001/gate. This LOW insures that Q5001 turns OFF. In this path, C5003 is charged to about 300Vdc, representing the crest of the oscillator waveform (at Q5001/drain).

Voltage Regulator

To maintain voltage regulation, the following parts are used:

Parts Used for Voltage Regulation	
Part	Purpose
D5007	Rectifies T5001 sample voltage
D5006 – 5.6V zener	Keeps Q5002 OFF so Q5001 can begin oscillating.
Q5002 – NPN	Controls the voltage at the gate of Q5001 for regulation

When the oscillator is running, the voltage at T5001/pin 6 is sampled and rectified. This sampled voltage passes through zener D5006 and is applied to error regulator Q5002. When the standby voltage is high, more current is applied to Q5002/base. Its increased conduction reduces the Q5001 gate voltage and the FET stays in conduction less. This change in duty cycle decreases the power available at the SBT T5001 secondary and the voltage is reduced.

Current Limiter

The current through Q5001 is limited by reducing its gate voltage. Since Q5001 and R5011 are in series, the current flowing through R5011 represents the current in the FET. If the current through R5011 drops 0.6Vdc, Q5002 begins to conduct. Its conduction reduces the FET gate voltage limiting its current so it does not overheat.

Additional Components

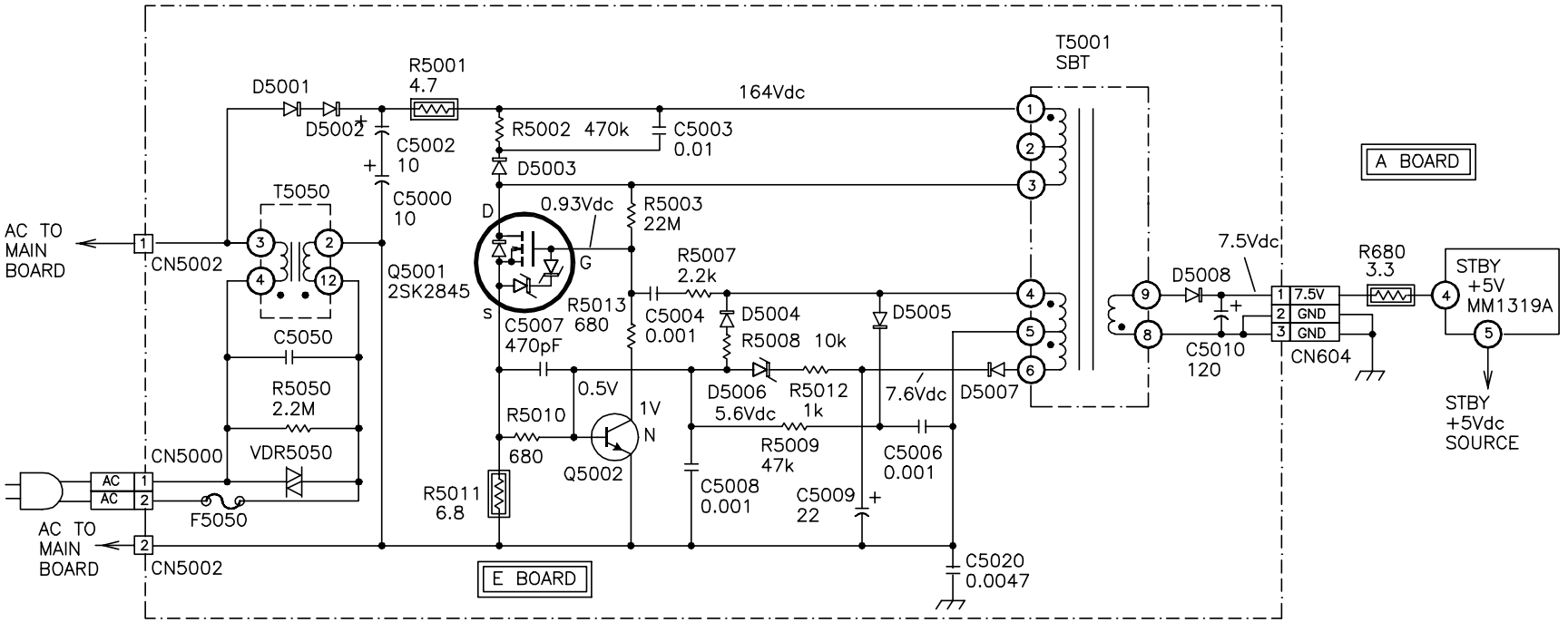
There are several additional components used in this circuit that have not been discussed:

Additional Components	
Parts	Purpose
D5005, R5009, C5008, C5006	Back up for voltage error regulator. Prevents excessive standby voltage. These parts limit the 7.5Vdc to 33Vdc if the main regulator path (D5007, R5012, or D5006) opened.
D5004, R5008	Keeps Q5002 OFF at the start up of the next oscillator cycle.

Testing

After replacing the Q5001 FET, and checking for shorts, increasing the AC voltage gradually is a good way to determine if there is an additional problem. The standby power supply is still connected to the load during this test so you must monitor the 7.5Vdc output voltage and prevent it from being excessive. The oscillator should start at about 35Vac. The normal operating voltages are listed in the chart below:

Normal Standby Oscillator Characteristics – KV27S45				
AC Voltage	R5001 Vdc	Q5001/D	Osc. Freq.	Output Vdc
20Vac	8.5Vdc	0	0	0
40Vac	47Vdc	180Vp-p	29.3kHz	7.4Vdc
60Vac	79Vdc	200Vp-p	50 kHz	7.56Vdc
80Vac	108Vdc	240Vp-p	61.6 kHz	7.6Vdc
100Vac	136Vdc	270Vp-p	69.6 kHz	7.6Vdc
120Vac	164Vdc	300Vp-p	74.2 kHz	7.6Vdc



STANDBY POWER SUPPLY

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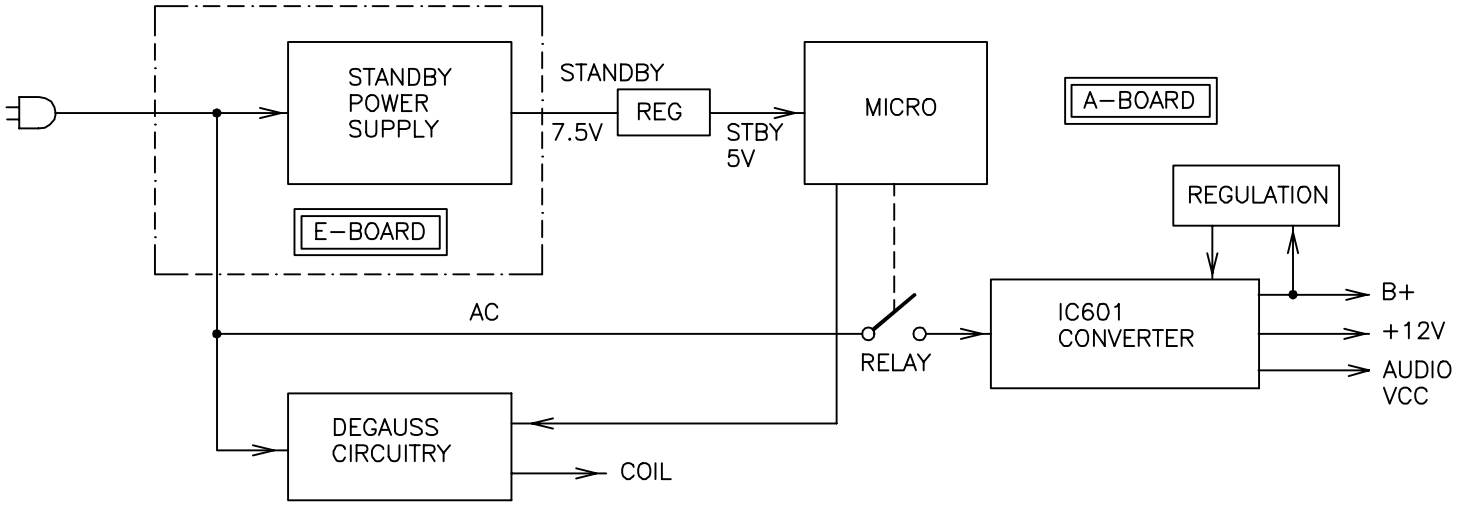


POWER SUPPLY BLOCK – 27" MODELS & LARGER

CTV25J38 891 8 13 98

B+ Regulation – 27” TV

The primary purpose of this stage is to regulate the B+ voltage that outputs from power input transformer T603. The B+ voltage will remain at a stable +135Vdc because of this regulating circuit.

A soft start circuit is connected to this regulating stage to keep the B+ from rising above +135Vdc at power ON before the regulating circuit has had time to react.

Regulation

Power Input Transformer T603 has several secondaries that output three different voltages for the TV to operate. For regulation, the B+ output is used as a sample and the +12V output is used in the control.

The B+ voltage is sampled and used to control the converter oscillator frequency. Changing the frequency of the oscillator in turn changes all the outputs from the T603 transformer, including the B+. This regulation method allows the B+ voltage from T603’s secondary winding to be maintained at a constant level.

Resistor R699 samples the B+ voltage from PIT T603 and applies it to power control/error regulator IC603/pin 1. The IC602/pin 4 output is inverted from the input so if the B+ voltage increased, IC602/pin 4’s output decreases. Therefore IC603 is seen now as an error regulator.

Error regulator IC603 is used to control the converter oscillator frequency. IC603 changes the current through PRT transformer T602’s control winding at pins 7-8. Current thorough the control winding reduces the effective inductance of this special transformer. When the inductance of a resonate circuit decreases, its oscillator frequency increases. Therefore, current through the control winding of PRT transformer T602 sets the converter frequency.

The secondary output of the Power Input Transformer T603 is determined by the converter frequency input to its primary. The converter oscillator waveform is applied to a tank circuit consisting of C614 and T603 which is resonate at about 60kHz in this TV set. T603’s output is a bell shaped power curve shown in the diagram. The oscillator frequency input to this tank circuit is to the right of the resonance peak at point A. Therefore the output of T603 is not at maximum. By changing the frequency of the oscillator, the secondary power output of the PIT T603 can be adjusted to provide sufficient load current while maintaining the same B+ voltage. This is why IC603 is labeled a power control device.

Soft Start Circuit

The soft start circuit consists of Q608, C632 and the PRT transformer T602. Its purpose is to keep the B+ voltage initially low at power ON.

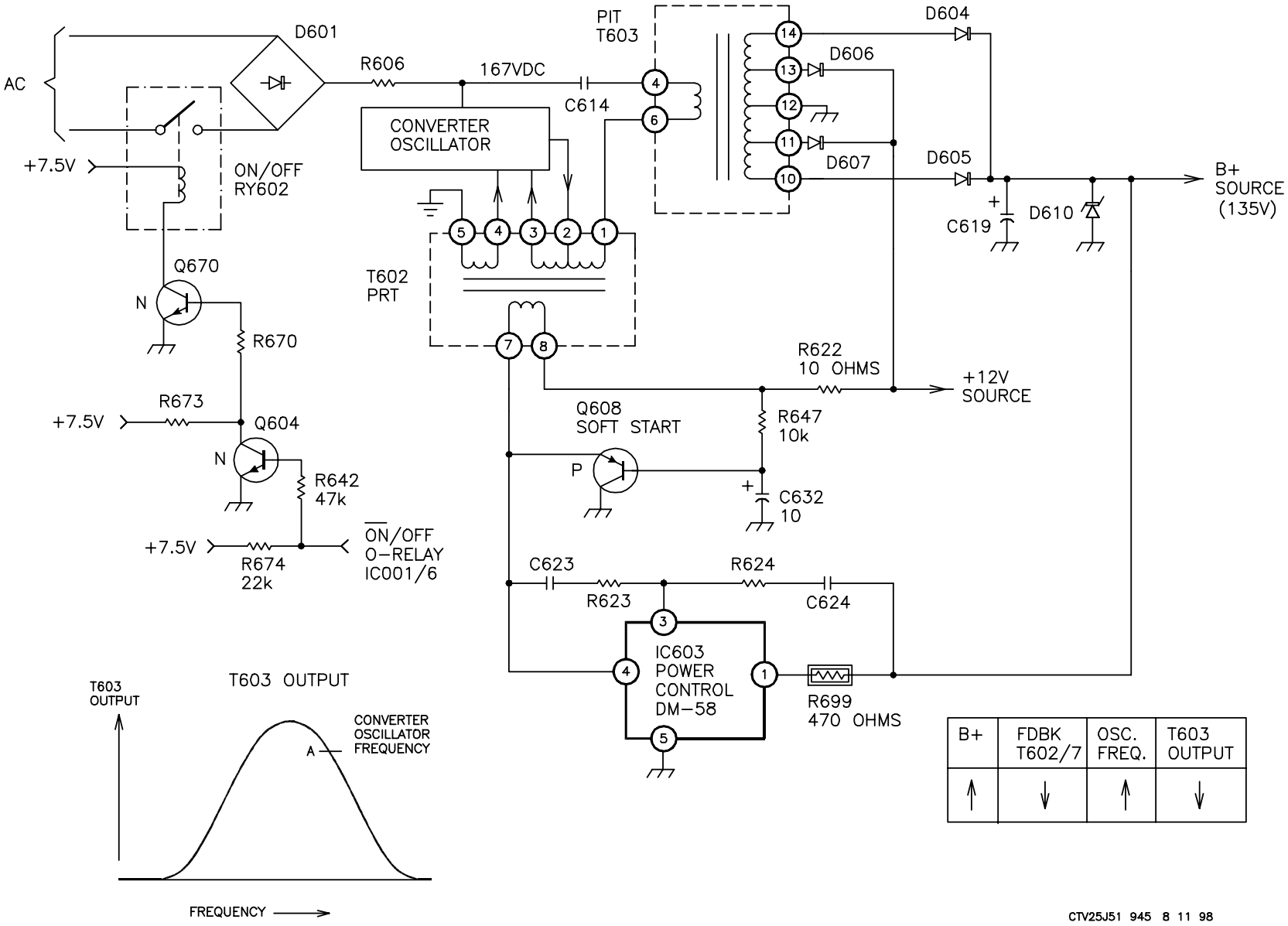
When the TV is turned ON, the following devices energize the power relay, supplying power to the converter oscillator.

TV Power ON	
Device	State
Micro IC001/pin 6	LOW
Q604	OFF (collector is +7.5Vdc)
Q670	ON (collector is 0.3Vdc)
RY602	Energized (contacts closed)

When power is applied to the converter oscillator, voltage is output the secondaries of PIT T603. Current from D606 and D607 (+12V source) takes the following path to ground:

Soft Start Path		
Part	Input	Output
D606 & D607	Anode	Cathode (band end)
R622		
T602 PRT		
Q608	Emitter	Base
C632	+	-
Q608	Emitter	Collector (ground)

This path causes current to flow through T602’s control winding at pins 7-8. Current flow in this control winding causes the converter oscillator frequency to shift to a higher frequency at start up. This keeps the B+ voltage low so it does not rise above +135Vdc at power ON.



B+ REGULATION – 27" TV

Power ON/Communications Block

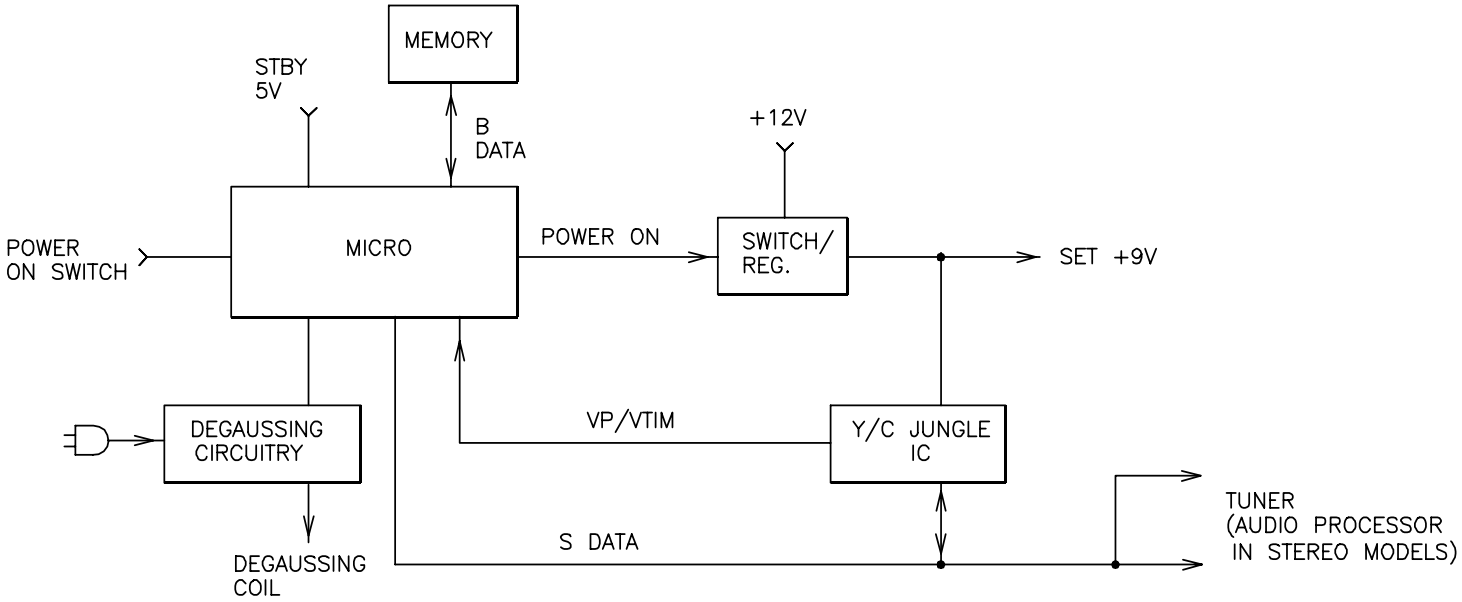
A number of processes occur when the power ON button is pressed. Below is a list of the sequence of operation and their purpose:

Power ON Sequence		
Block	Operation	Purpose
1. Press ON button	Power ON	Start command
2. Micro -Degauss circuitry	Degaussing	Eliminate magnetized areas of the picture tube
3. Micro – Switch/Regulator	Regulator ON.	Switch ON the SET +9Voltage to power the Jungle IC
4. Sw/Reg – Jungle IC	Jungle power	Vcc to jungle IC
5. Jungle IC - Micro	Vertical Interval Timing signal (VTIM)	Vertical oscillator pulse output for data timing
6. Micro – Memory IC	Stored data retrieval from memory: 1. Last TV station, 2. Input used, 3. Picture settings, 4. Volume levels, 5. TV ID (features)	Pulls last active user information from memory
7. Micro – Jungle IC, Tuner, Audio processor.	Communications	Data and clock are used to notify the other ICs to return to the former TV condition at power down

Data and clock communications signals are high rise time waveforms with harmonics. To avoid communications interference with the picture, the microprocessor only communicates with other ICs during the vertical interval time above the picture. To locate this time, the Micro uses the vertical timing (VTIM) signal from the jungle IC.

In previous Sony TV sets, the 60Hz VTIM signal was crucial to the starting operation of the microprocessor. If there was no VTIM signal into the Micro, there was no data (or clock) signal output and the TV would not work.

In the BA-4 chassis, when there is no VTIM signals input, serial data will still output the microprocessor. As a result, the TV will turn ON, but the data and clock communications will be at a lower (50Hz) frequency.



POWER ON/COMMUNICATION BLOCK

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Degaussing Circuitry

Concept

The picture tube has three electron beams that are targeted to exact locations on the phosphor screen. If a magnet were brought near the picture tube, the electron beams would be attracted to it. The electron beams would move out of place and not land on their correct phosphors. When they strike the wrong phosphors, a predominate color pattern appears at that portion of the screen near the magnet. If only one electron beam is turned ON, the TV screen will not display a pure single color screen. This is called a purity problem.

Placing speakers next to the TV commonly causes purity problems. The magnets within the speakers disturb the beam landing. However, the internal speaker's magnet is fully shielded to prevent this problem.

Electrical appliances that contain motors, placed near the TV or turned OFF at the TV, will also cause a purity problem. In this case, turning OFF the appliance magnetizes metal areas of the picture tube's aperture grill causing the purity problem.

The earth's terrestrial magnetism can also magnetize parts of the picture tube's aperture grill when the TV is moved. The degaussing circuit eliminates these magnetic effects on the aperture grill.

The purpose of this degaussing circuit is to demagnetize the aperture grill at plug in and each time the TV is powered ON. This is done by passing AC through a coil of wire located at the bell of the picture tube. The AC field created eliminates the magnetized areas of the aperture grill.

Circuit Operation

Micro IC001 controls the degaussing relay. At plug in, Micro IC001 has received standby +5Vdc and a LOW at IC001/pin 30 for reset. After the reset line goes HIGH, IC001 can respond to the Power ON command. Immediately the degaussing output line at IC001/pin 13 goes HIGH to start degaussing. This HIGH is applied to Q601's base, turning the transistor ON. Current flowing through Q601 also flows through the RY601 relay coil, energizing the degaussing relay.

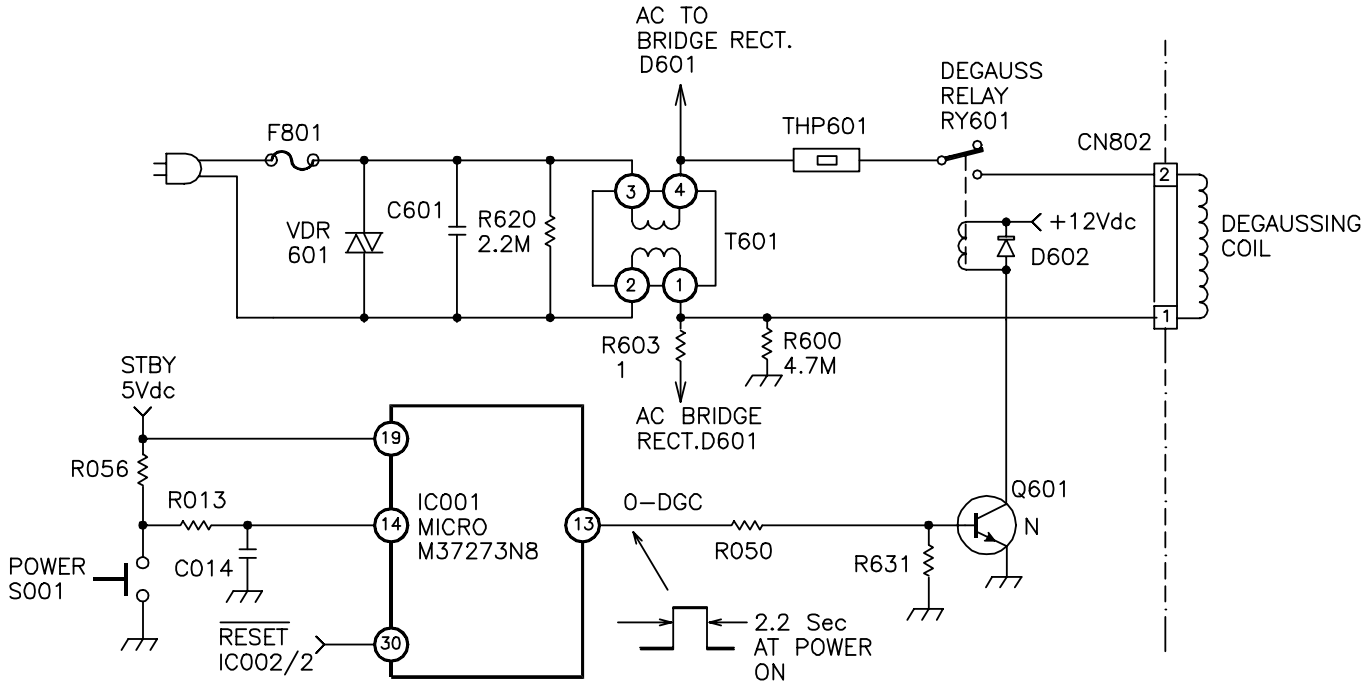
AC current from the 120Vac line can pass through the relay into the degaussing coil. The 120Vac input must first pass through several parts before reaching the degaussing coil:

Parts between the AC Line and the Degaussing Coil	
Part	Purpose
VDR601	Absorbs voltage spikes from the AC line.
C601	Reduces voltage spikes from the line and from the TV (converter stage).
R620	Bleeder resistor for C601
T601	Common mode rejection transformer. Cancels opposite polarity noise signals on the AC line.
THP601 3.5 ohms cold 14kohms hot (calculated)	Degaussing thermistor is 3.5 ohms cold in series with the degaussing coil. It increases in resistance to almost turn OFF all the coil current within 2 seconds.
RY601 Coil = 273 ohms	Controlled by IC001 to apply AC to the degaussing coil for 2.2 seconds.
Degaussing coil Approx. 8 ohms	Creates an AC field that erases magnetic effects of the aperture grill.

Thermistor Operation

When current flows through the degaussing coil, it also flows through the THP601 thermistor. Initially its resistance is 3.5 ohms, but increases rapidly so that within two seconds there is only 8.5ma flowing through the degaussing coil. This current develops a negligible magnetic field in the coil and is effectively OFF. Shortly after the thermistor has reached its highest resistance, the RY601 relay disconnects the degaussing coil from the AC line completely.

Degaussing Coil Current	
Power ON	10Amps (momentary)
1.7 seconds after power ON	8.5ma. (thermistor operation THD601)
2.2 seconds after power ON	0 ma.



DEGAUSSING CIRCUITRY

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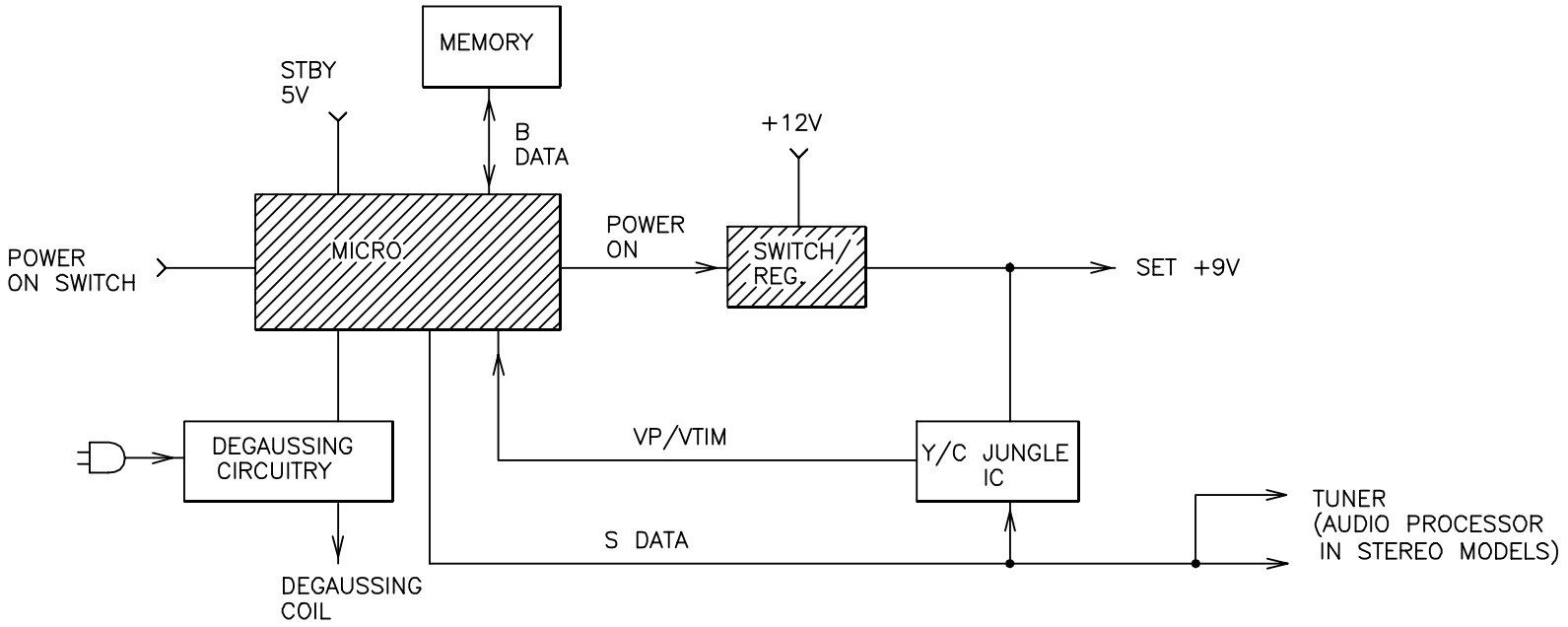

POWER ON/COMMUNICATION BLOCK

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Power ON

Power ON

Once the Micro has received Standby +5Vdc at plug in, the external 8MHz crystal can run (even while reset). This 8MHz is used for all sequential digital based operations in IC001 and consequently is necessary for any activity.

Now that the Micro is ready, it can respond to a power ON command. The ON command can come from the front panel S001 switch or the remote control. Either input causes IC001 to respond at the following outputs:

Micro Output at Power ON	
Output	Purpose
1. IC001/pin 13 = LOW	Activates the degaussing circuit
2. IC001/pin 6 = LOW	Turns ON the Set +9V regulator Q605

The LOW output from IC001/pin 13 is applied to the degaussing circuitry. It only remains LOW for 2.2 seconds each time the TV is turned ON. This is more than enough time needed for the degaussing operation.

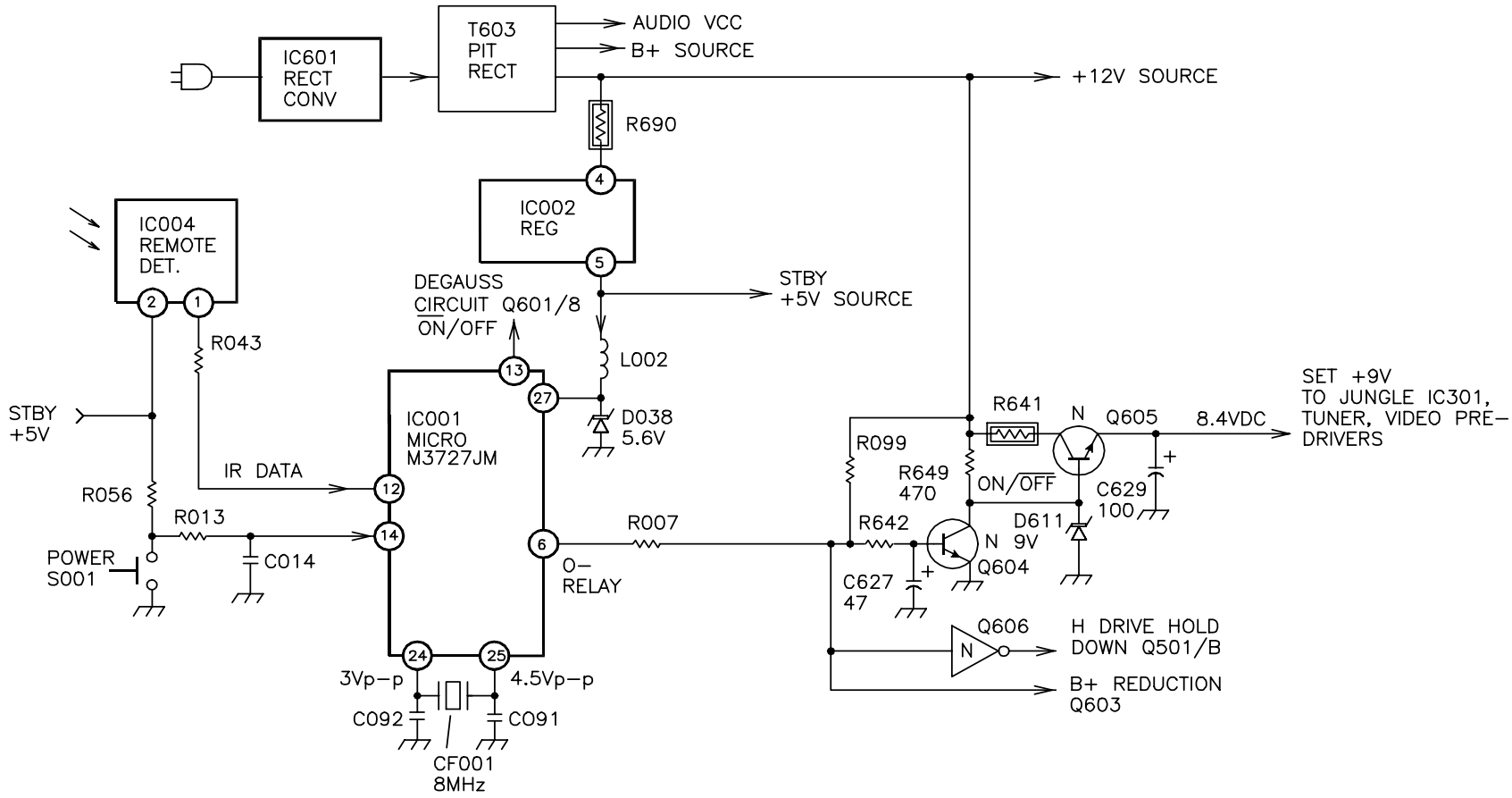
The LOW output at IC001/pin 6 is applied to Q604 and Q605. It remains LOW as long as the set is ON. The LOW is applied to the base of switch Q604, turning it OFF.

With Q604 turned OFF, its collector voltage is allowed to rise to the zener voltage of D611 (+9Vdc). The zener voltage comes from pull up resistor R649 connected to the +12 volt source. The +9Vdc back at the zener diode's cathode is connected to the base of regulator Q605. The positive voltage will forward bias Q605 so its emitter will output "Set +9V" (actually +8.4Vdc). This Set +9V is the source of Vcc power for the Jungle IC to begin the TV set operation.

Power OFF

Additional circuits connected to IC001/pin 6 are used during power OFF to insure proper turn OFF. This is because only the Set +9Vdc is removed at power OFF while the remaining converter voltages are present to many circuits.

Circuits Used During Power OFF		
Transistor	Name	Purpose
Q606	Horizontal Drive Hold Down	Grounds the horizontal drive to assure no FBT secondary voltages.
Q603	B+ Reduction	Prevents excessive B+ when there is no load at power OFF



POWER ON

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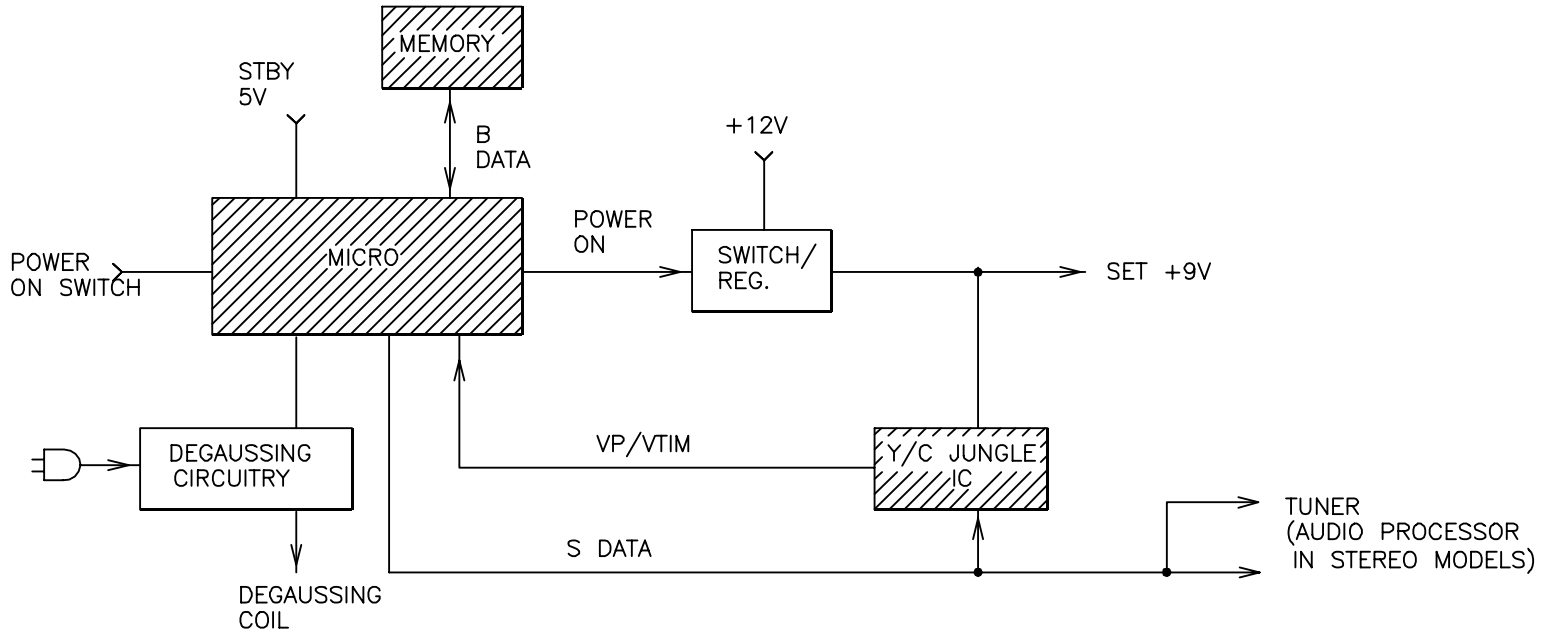

POWER ON/COMMUNICATION BLOCK

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Communications

Before normal communications can begin, start-timing pulses are needed. Then Data and Clock (I^2C) communications will run as long as the set is powered ON.

Start

Once the TV is powered ON, Set +9Vdc is available to the Y/C Jungle IC301 at pin 44. Then IC301's internal oscillator starts, making horizontal and vertical drive signals and a 60Hz Vertical Timing (VTIM) pulse from pin 5. This 60Hz VTIM pulse begins the communications by telling IC001 when to begin sending out Data and Clock signals.

Run

Memory Retrieval

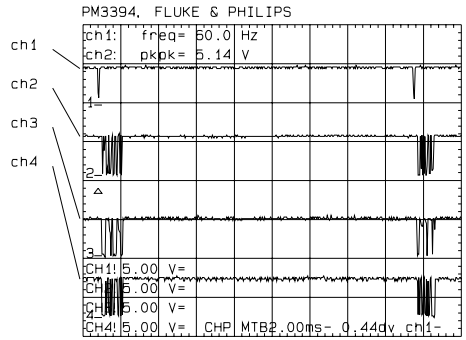
Micro IC001 first communicates with the memory IC003. TV settings were stored into memory IC003 the each time they are changed while the TV was ON. At power ON, IC001 sends out clock and data communications to Memory IC003 to retrieve this information. The return data is sent back to IC001 on the same data line (IC001/pin 36 – IC003/pin 5) and is supported by clock signal from IC001/pin 39.

User Settings Transferred from Memory

The user settings stored in memory will include:

- TV station – last station used, CC, channel block, favorites
- Input Selection - Video 1, Video 2, or TV input
- Picture settings – Brightness, color, sharpness, etc. (if not at default level)
- Volume – level, tone, balance, speaker ON/OFF

The waveform of the VTIM signal is shown preceding the IC003 memory data and clock signals.



TV ON - Active channel.

Channel 1 – IC301/pin 5; VTIM

Channel 2 – IC001/pin 36; Bi-directional Data

Channel 3 – IC001/pin 39; Clock Output to IC003

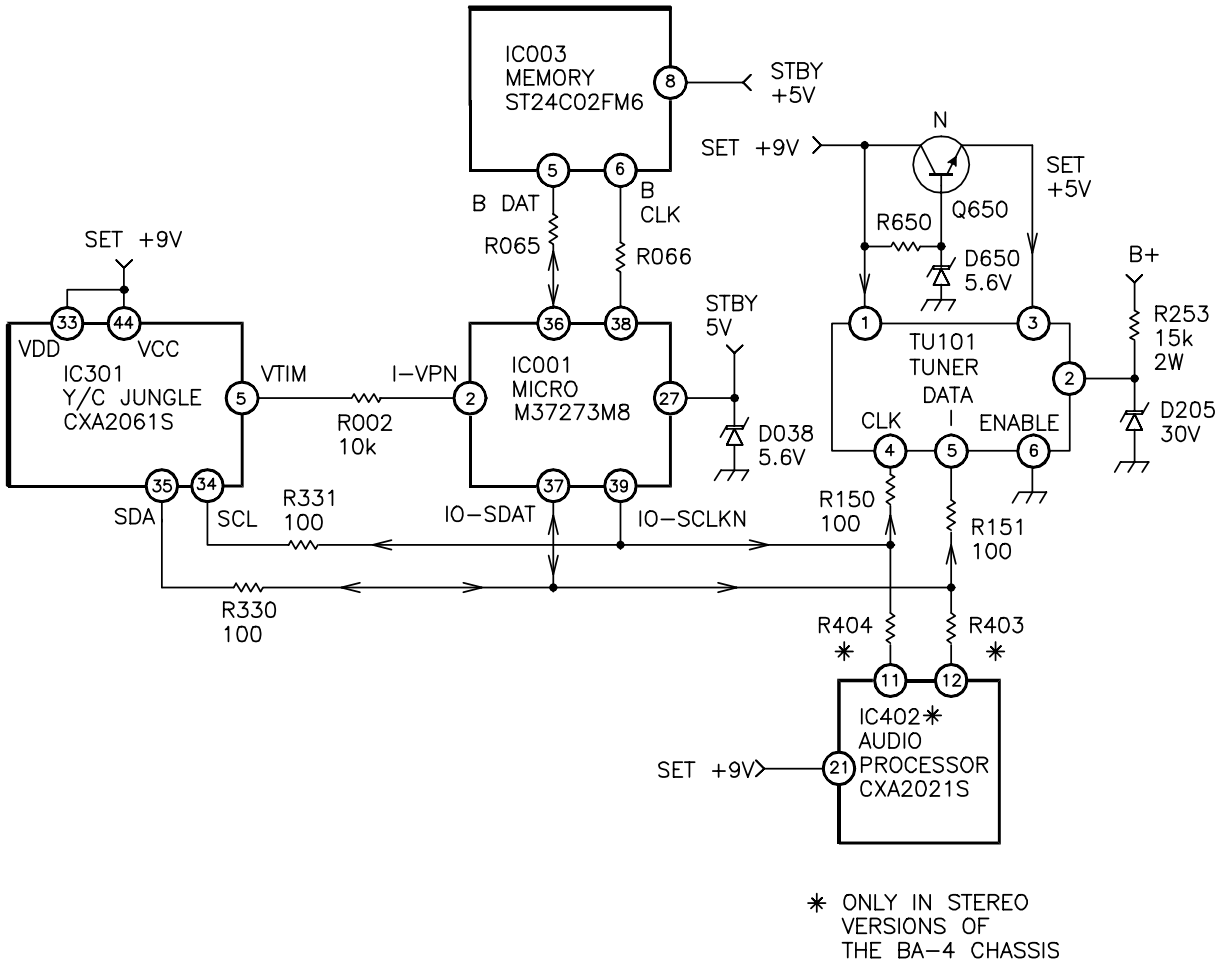
Channel 4 – IC001/pin 37; Bi-directional Data

All waveforms at 5V/div.; Time base = 2msec/div.

ID Code Transferred from Memory

In addition to the user data transferred from memory into IC001, operating parameters such as size, gamma, linearity, and the TV's ID codes are also transferred.

These ID codes identify the model's features. Having the wrong codes will permit the TV to display parts of a feature that does not exist in that model. For instance, a video 3 may appear on the OSD when there is no video 3 input. These ID codes are accessible for check and correction from the service menu (see the service manual for access information from the remote control).



COMMUNICATIONS

CTV25J18 871 8 11 98

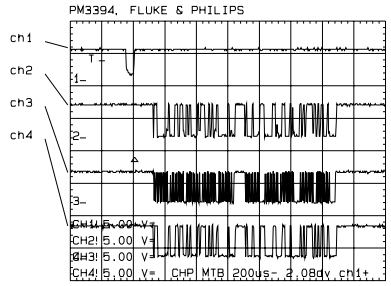
Below is a chart showing the ID codes for the current BA-4 chassis.

ID Codes for the BA-4 Chassis								
Model KV -	ID-0 * Country	ID-1	ID-2 Stereo	ID-3	ID-4	ID-5	ID-6	ID-7
13M40	25	1	0	3	19	0		
13M50 /51	25	3	0	3	19	1		
20M40	25	3	0	131	23	1		
20S40/ 41	25	3	1	131	23	1		
20V80	25	19	13	131	31	1		
27S40	153	1	13	195	31	1	0	64
27S45	153	27	13	195	31	1	1	64
27S65	153	27	27	15	195	31	7	64
* The Canadian version is a 9 instead of 25 and 129 instead of 153.								

Communications with other ICs

After the memory IC003 information is stored in the working static memory inside IC001, the information is communicated to the Jungle IC301, Tuner TU101, and audio processor (IC402 if used) to set up all the operating parameters of the TV.

In this second scope shot, the same data is shown expanded so you can see there is a space in the clock signal from IC001. It also can be seen that the memory data and jungle data seem to be alike.



TV ON - Active channel.

Channel 1 – IC301/pin 5; VTIM

Channel 2 – IC001/pin 36; Bi-directional Data

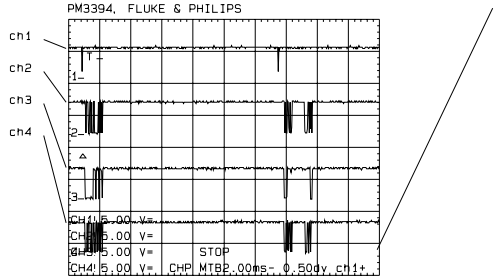
Channel 3 – IC001/pin 39; Clock Output to IC003

Channel 4 – IC001/pin 37; Bi-directional Data

All waveforms at 5V/div.; Time base = 200usec/div.

Channel UP Command

This third scope shot shows that additional data and clock are added to the communications line when the channel up (+) was pressed. Similar data is present when other buttons such as video selection, volume and display are pressed.



TV ON – Remote Channel Up button pressed.

Channel 1 – IC301/pin 5; VTIM

Channel 2 – IC001/pin 36; Bi-directional Data

Channel 3 – IC001/pin 39; Clock Output to IC003

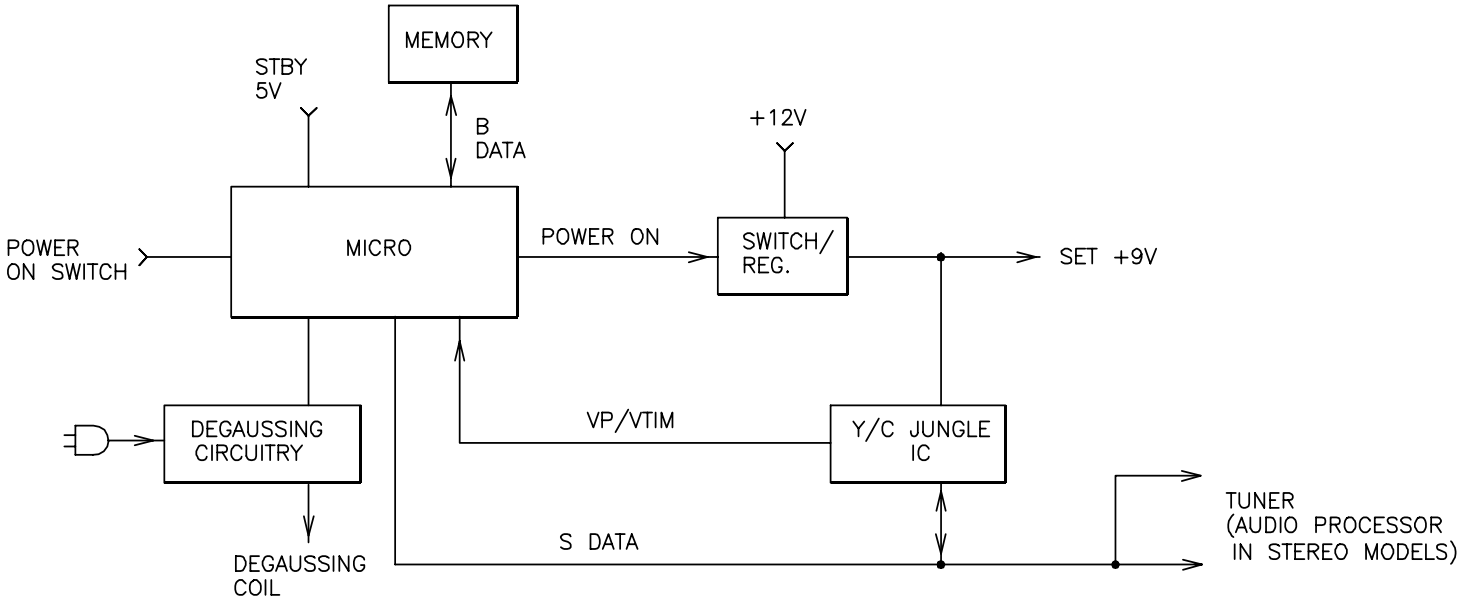
Channel 4 – IC001/pin 37; Bi-directional Data

All waveforms at 5V/div.; Time base = 2msec/div.

Missing VTIM Timing Signals

Unlike previous Sony TV sets, in the BA-4 chassis if the VTIM timing signal from IC301 were missing, data and clock would still output the Micro IC001/pins 36-39 and the set would appear to function normally except there would be no on screen display (OSD). The OSD needs vertical and horizontal timing pulses for positioning. Without either pulse the OSD characters would not know where to appear.

The frequency of the data communications when this VTIM signal is missing is about 50Hz. Normally the data and clock follow the 60Hz VTIM signal. In the previous Sony TVs, if the VTIM signal were missing, neither data nor clock would output the Micro. The symptom is that the set would remain blanked because there is no data to the Jungle IC. This is no longer true starting with this year's BA-4 TV chassis.



POWER ON/COMMUNICATION BLOCK

CTV25J24 877 8 11 98

Video Processing Block

Tuner

The Micro controls the tuner through the use of data and clock communications. Both share in the TV station tuning functions:

TV Tuning Functions	
Micro	Tuner
Data output identifies TV bands (Low/high VHF, UHF, Cable) and TV channel.	Uses input data to change the internal local oscillator frequency for station selection.
Data output uses AFT feedback to fine-tune the TV station.	Outputs center of station AFT voltage.
Uses TV video sync to ID an active TV station (auto programming).	Outputs TV video and audio signal
Memorizes the location of active TV stations (external memory IC).	

Video Inputs

In the 20" and smaller screen size BA-4 chassis, video input selection is performed by the Jungle IC. As many as three video inputs are available for the user to select from:

- Tuner video
- Video 1 – composite or S video
- Video 2 – composite video only

When the S video 1 jack is present in a model, the composite video 1 input signal must pass through the S video jack. The composite video 1 signal leaves the jack at the luminance (Y) line to the Jungle IC. When S video 1 is input, the round S video plug grounds the SW input to the Jungle IC so it knows to route the separate Y and C inputs differently.

In the 27" screen BA-4 chassis, there maybe an additional video input and video output jack. Therefore, a video switcher IC is used before entering the Y/C Jungle IC as composite video or Y & C (S video).

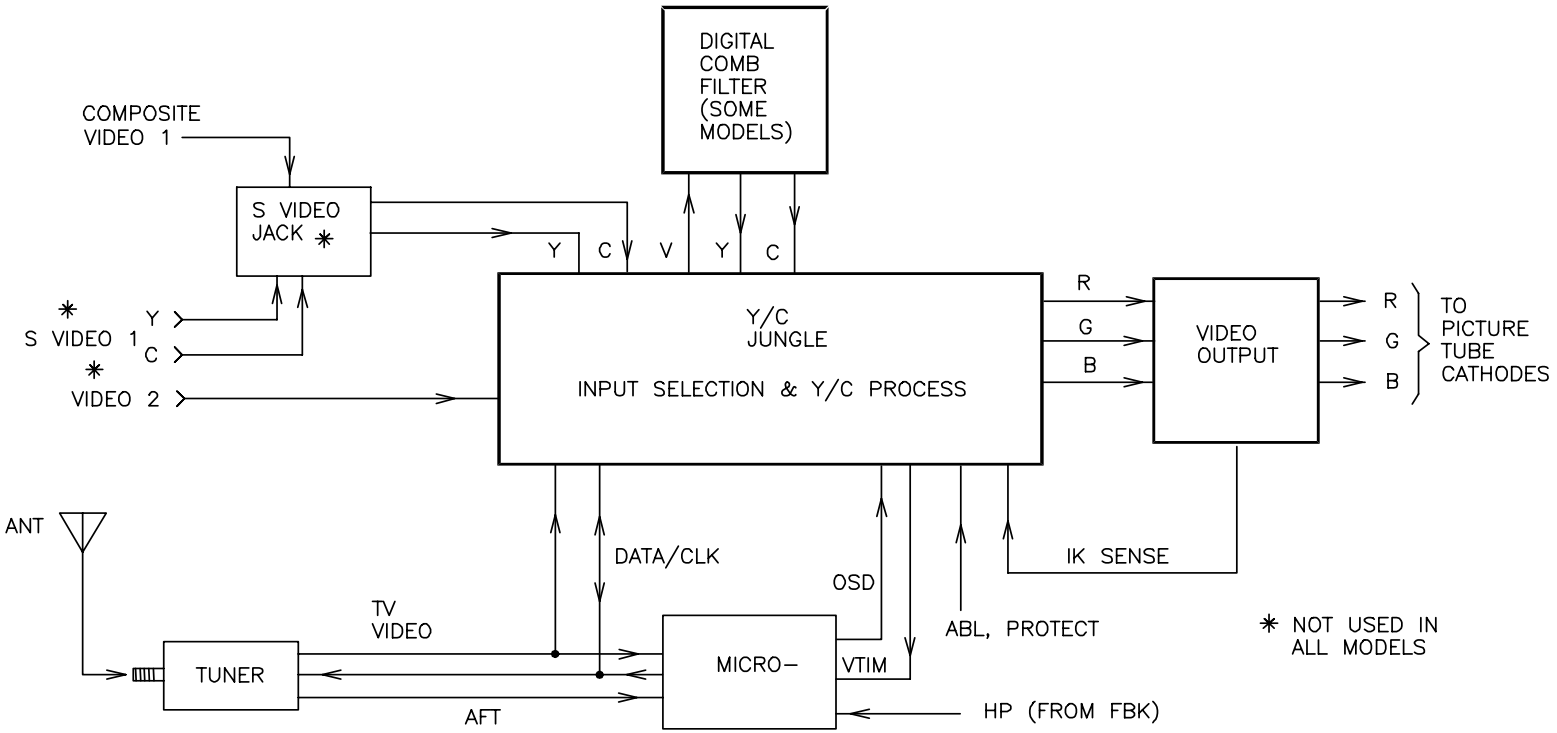
Digital Comb Filter

Some TV models have a digital comb filter connected to the Y/C Jungle IC. These models must be identified to the Jungle IC so it knows to route composite video (V) out to the filter and receive luminance (Y) / color (C) information from the filter as a departure from the internal video-processing path. Data from the Micro identifies the presence of the external comb filter. This data comes from ID codes found in the Micro and memory IC. The technician can access them from the service mode (further information is in the service manual).

The purpose of a comb filter is to separate a composite video signal's luminance (Y) information from its color (C) information. Digital comb filters have gone further. There are currently four types of comb filters available on the TV market:

1. Analog Comb Filter - This type of filter will help increase the picture resolution to above 330 lines.
2. Digital Comb Filter – This performs the same function, but the separation is done in the digital domain.
3. Digital 2-D Adaptive Comb Filter – This filter employs a memory to analyze the picture information in two dimensions (2-D), vertically and horizontally.
   The result is not only Y/C separation, but also higher resolution than a standard digital comb filter by simulating detail and reduction of dot crawl. The word "Adaptive" indicates that the digital processing is constantly analyzing and selecting the best algorithm available in the filter.
4. Digital 3-D Adaptive Comb Filter – This filter is an improvement over the 2-D that only processed information within that field. The 3-D filter analyzes information over frames to compare and eliminate noise, interference and irregularities, as well as separate the Y from the C.

Different digital filters are used in different models of Sony TVs.



VIDEO PROCESSING BLOCK

CTV25J36 889 8 17 98

Video Output

The video processing continues from within the Y/C Jungle to the picture tube. The Y/C jungle IC takes the composite video or S video and converts this information into separate R, G and B voltage levels. These voltages are amplified by the video output stage and applied to the picture tube cathodes.

On Screen Display

The TV's menu, channel information and input selected are introduced into the video path in the last stages of the Jungle IC. This alphabet character information is called On Screen Display information (OSD). It comes from the Micro and is sent to the Jungle IC as OSD voltages. Since the Microprocessor needs to know exactly where to place these characters, it is essential that horizontal (HP) and vertical (VTIM) timing pulses are input or there will be no OSD.

IK Sense Circuit

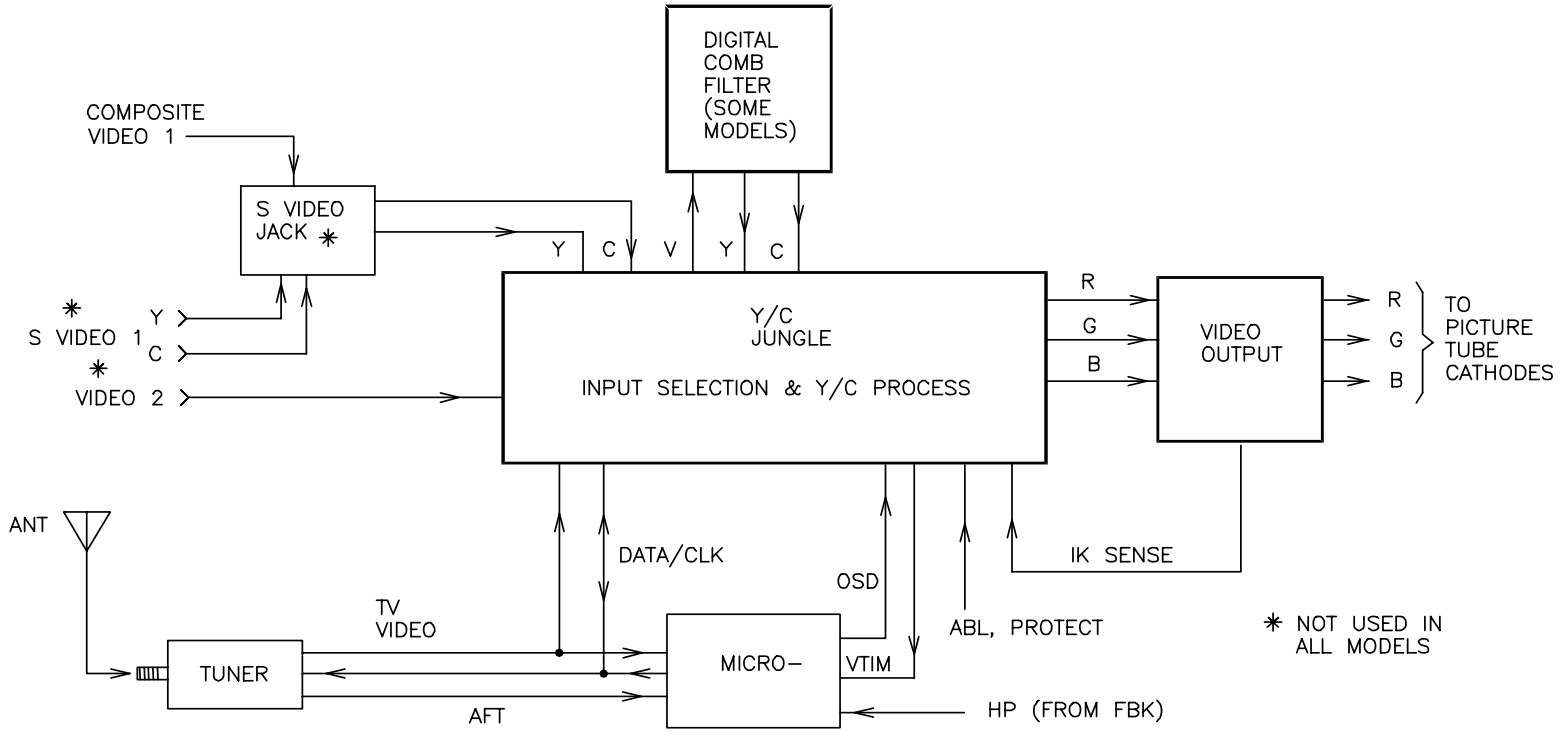
The Jungle IC adjusts the levels of each R, G and B signal to maintain a level of white balance. The current drawn by each picture tube cathode is monitored as long as the TV set is ON. The monitoring process results in three pulses that reside in the vertical blanking (invisible) area of the picture. Each pulse corresponds to the three cathodes of the picture tube. These IK (cathode current) sense pulses are separated by the Jungle IC and used to adjust the R, G and B levels to maintain white balance.

ABL

The Automatic Brightness Limiting input monitors the current drawn by the picture tube's high voltage. If the picture gets suddenly bright, this ABL voltage input to the Jungle IC causes a reduction in R, G and B output levels.

Protection

The protection circuitry monitors B+ current, and flyback voltage. If either signal is excessive, the Jungle IC sends data to the Micro to turn OFF the TV set.



VIDEO PROCESSING BLOCK

CTV25J36 889 8 17 98

TV Reception

Reception from Power ON

Station Information

At power ON, TV station information is sent from the Memory IC003 to Micro IC001/pin 37. This information contains:

- The active TV stations
- Each of the station's frequency and band locations
- The last station watched at turn off

Coarse Tuning

TV station reception is performed using Micro IC001 and Tuner TU101. The last station watched with its frequency and band location information is transmitted by data to the tuner TU101/pin 5. In TU101, the band and frequency data are used to tune to the desired station.

Fine Tuning

An analog AFT voltage from the TU101/pin 4 is used to fine-tune the station. When the station is on frequency, the Automatic Fine Tuning (AFT) voltage from TU101/pin 10 is 0.7Vdc. If the station is off frequency, this AFT voltage will be 0 volts or as high as 1.2Vdc. The off frequency error is detected by Micro IC001/pin 34. IC001 sends frequency correction data from pin 37 to TU101/pin 5. The station's frequency is fine-tuned and the AFT voltage is brought to 0.7Vdc.

Video Output

2Vp-p of TV video is output the Tuner at pin18, buffered by Q205 and fed to the Jungle IC301/pin 43.

Video Output Level		
Location	DC Voltage	Vp-p
TU101/pin 18	4.3Vdc	2Vp-p
Q205/emitter	5Vdc	2Vp-p
Q390/emitter	3.7Vdc	2Vp-p

Channel Change audio mute

By pressing the channel + or – buttons on the front panel or remote control, IC001 responds with data from pin 37 for the tuner to change a station. At the same time, Micro IC001/pin 5 outputs a 1 second positive pulse that is applied to TU101/pin 17 to mute just the audio. This insures no audio noise is heard when changing stations.

The mute output from IC001/pin 5 also goes HIGH when the volume down button is pressed and the level has reached its lowest limit. IC001/pin 5 also goes HIGH when the mute button is pressed. This is summarized in the following chart:

Audio Mute from IC001/pin 5	
Operation	Interval
Channel change	1 second.
Volume all the way down	Until volume up is pressed.
Mute button pressed	Remains HIGH until TV is turned OFF.

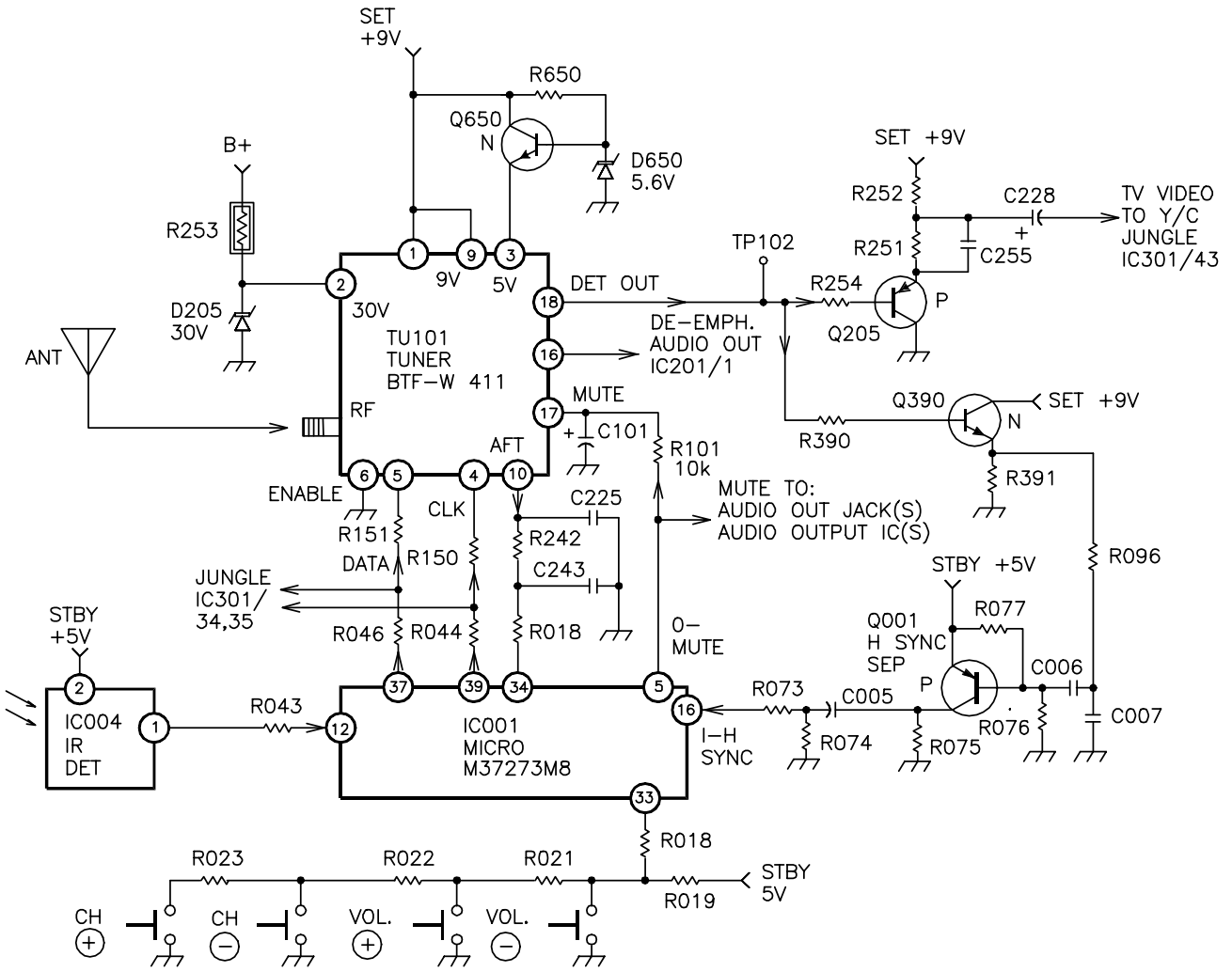
Auto Station Programming

Station identification is used during the TV's auto station programming. This is when all the cable or over the air active stations are selected over the inactive ones. Each channel is polled one by one. When there is horizontal sync received at that channel, the station is deemed to be active. This channel location is then stored in IC001 to be transferred to an external memory IC at power OFF.

When this feature is activated from the user's menu, IC001 sends data to the tuner to tune to each channel to see if there is a station present. If a station is present at the first channel location, video will output the Tuner TU101/pin 18. This video is buffered by Q390, leaving its emitter for Q001's base. Q001 is a sync separator that passes just the sync tips of the video waveform into IC001/pin 16. It is these horizontal sync tips that are identified by IC001 and the channel is logged as being active at this time.

For reference the DC voltages at sync separator Q001 are listed:

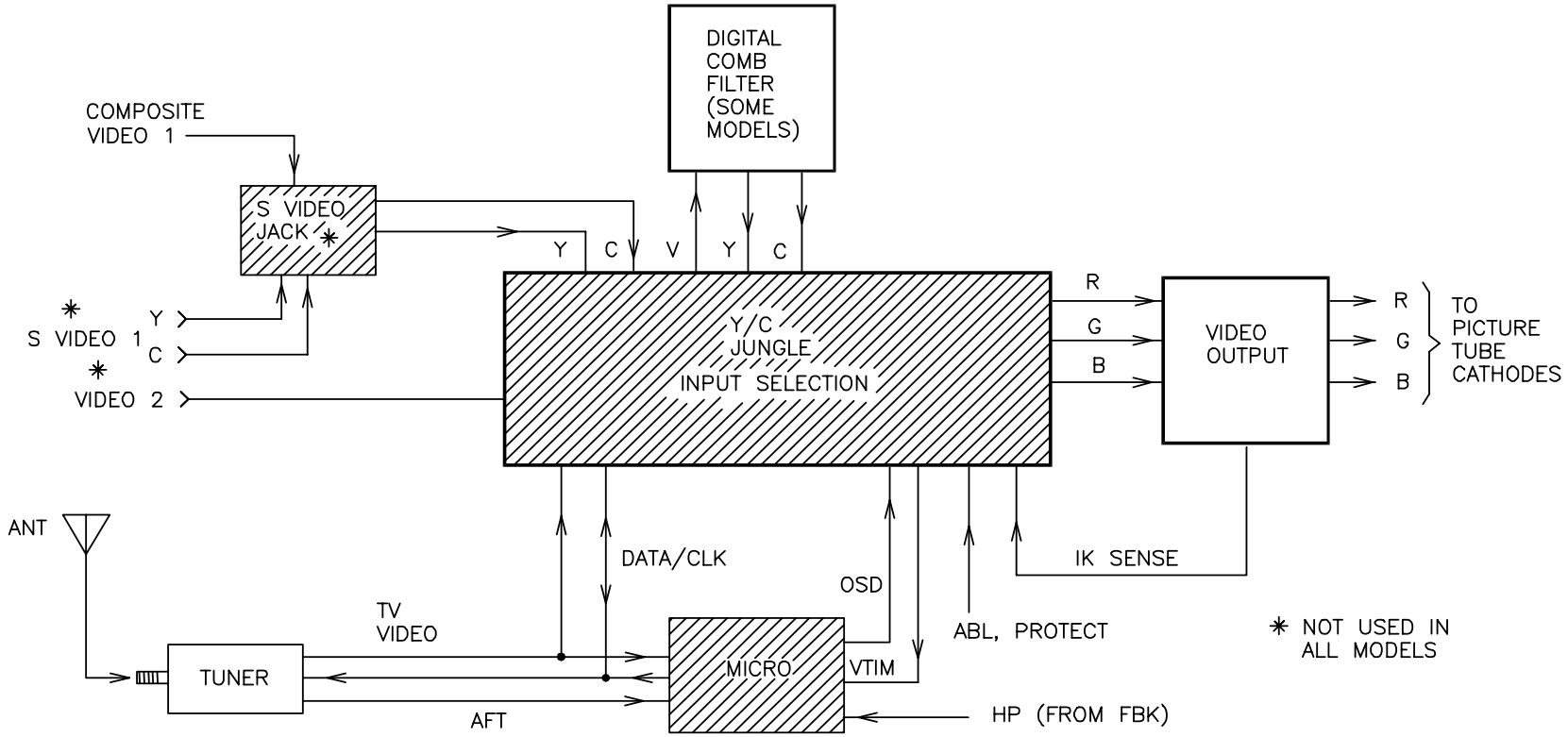
On station	E = 5.1Vdc	B =5Vdc	C = 0.7Vdc
Off station	E = 5.5Vdc	Same as above	C = 0.5-0.8Vdc



TV RECEPTION

CTV25J33 886 8 13 98

NOTES



VIDEO PROCESSING BLOCK

CTV25J4B 941 8 11 98

Video Inputs

The Y/C Jungle IC not only performs luminance (Y) and chroma (C) processing, but input selection as well. There are as many as seven inputs the Jungle IC can select from. They are shown in the chart below:

Jungle IC Inputs			
Name	IC001/ Pins	Switch	Access
Tuner	43	Data (IC001/pin 35)	Channel +/-, TV/video buttons
Video 1	2, & 4	Data (IC001/pin 35)	TV/video buttons
Video 2	41	Data (IC001/pin 35)	TV/video buttons
OSD *	30 – 32	5V positive pulses from IC001/pin 49 replace pieces of video with OSD character pieces. 2Vdc from IC001/pin 41 reduces video brightness (menu).	Display or Menu buttons.
Closed Caption (CC)	30 - 32	5Vdc from IC001/pin 49 blacks out video to form the CC text box and allow CC characters to appear.	Select caption vision from the Menu. CC does not appear in most programs.
Y & C from the comb filter	7, 9.	Data (IC001/pin 35).	Selected when the ID codes (service adjustment mode) identify the model with a comb filter.
Picture in Picture	37 - 39	YUV sw into IC301/pin 36. Switching pulse: High – PIP picture Low – Normal video input	PIP button on the remote control.
* OSD = On Screen Display of characters (menu or channel numbers)			

OSD and Closed Caption

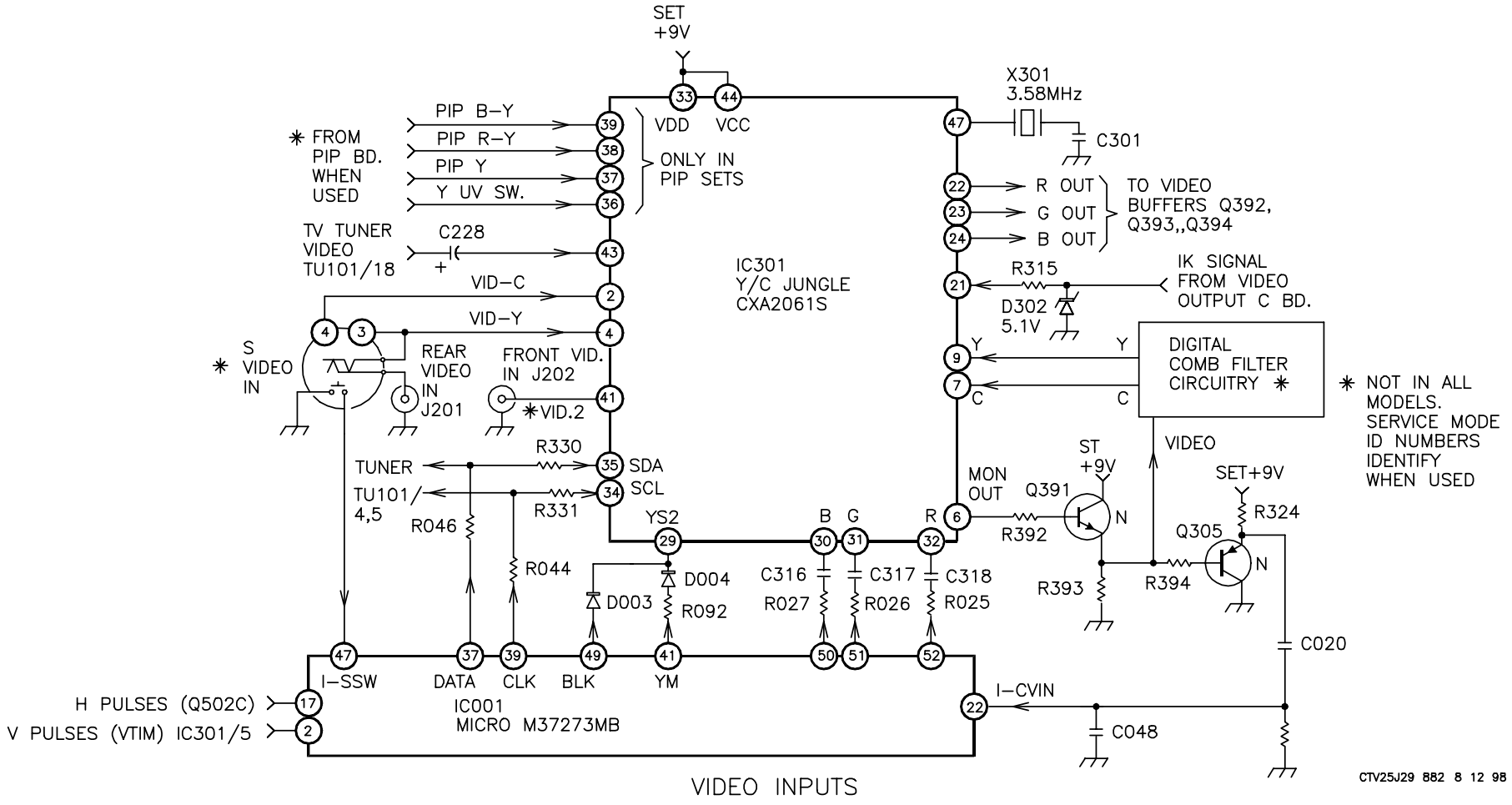
Before the OSD circuit can function within IC001, it needs timing signals. Horizontal pulses from the horizontal output transistor Q502/collector are applied to IC001/pin 17. Vertical timing signals from the Jungle IC301 are applied to IC001/pin 2. Both timing signals are necessary to position the OSD characters on the screen. If one were missing, there would be no OSD or CC text.

The OSD characters generated from IC001/pins 50-52 are accompanied by switching signals applied to IC301/pin 29. These switching signals must go HIGH to displace the input video and enable the OSD R, G and B that is input IC301/pin 30-32. Inside the Jungle IC, the R G, and B characters replace pieces of the video.

The level of voltage input to IC301/pin 29 determines if the input video is blanked or just reduced in brightness. If IC301/pin 29 is brought to 5 volts, the video will be blanked completely permitting the OSD to appear. If IC301/pin 29 is brought to only 2 volts, the video will appear at reduced brightness, such as when the menu button is pressed. The full 5-volt video-blanking signal comes from IC001/pin 49 and the ½ brightness signal comes from IC001/pin 41 via R092 (10Kohm).

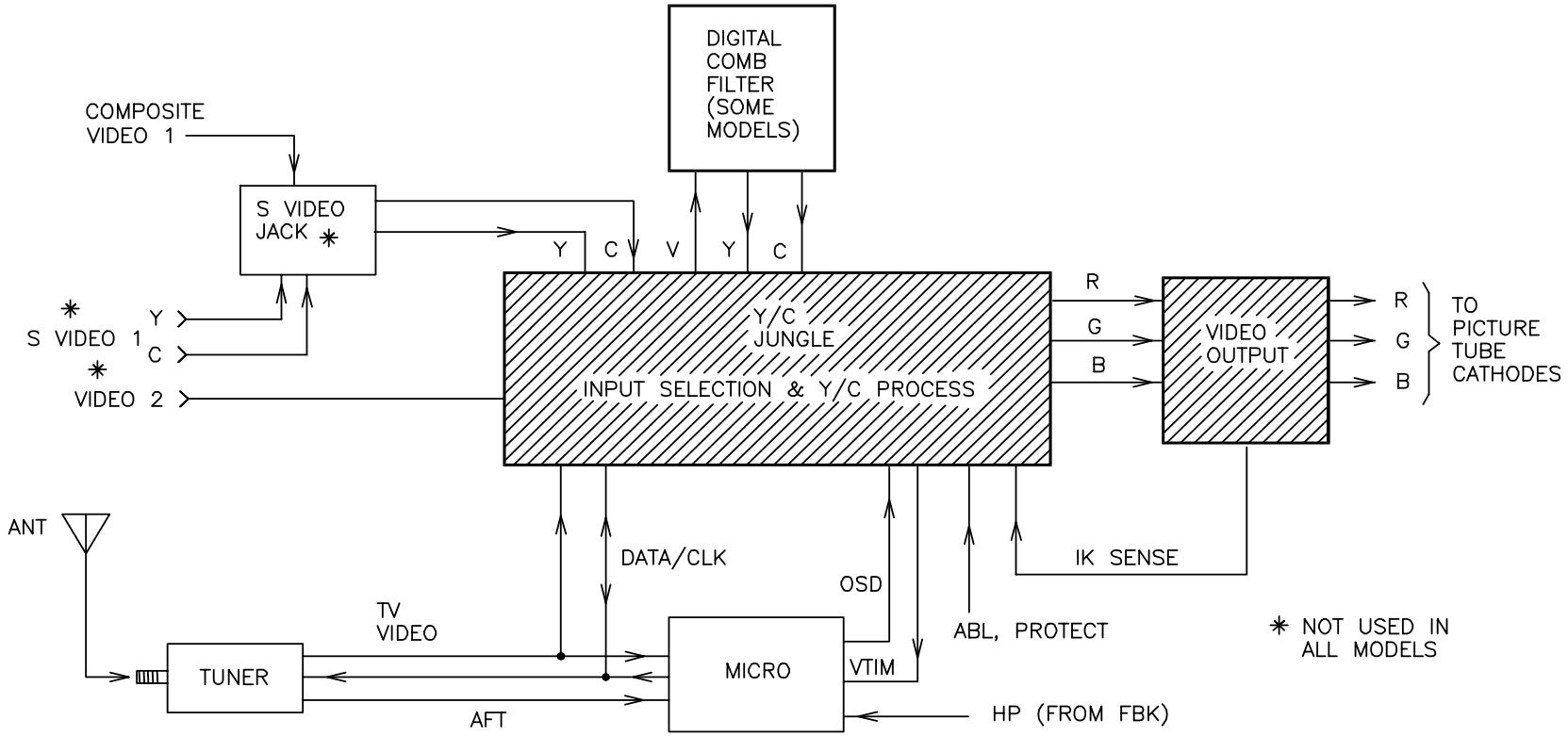
The closed caption stage is within Micro IC001 and only requires three signals for operation. The H & V sync information that is used by the OSD stage is also used in the CC circuits for positioning. Video input IC001/pin 22 to extract the CC information from a line in the vertical interval is the remaining signal necessary for operation.

Additional Signals necessary for the OSD and CC to function		
	Input	Location
OSD	Horizontal pulses Vertical pulses	Q502/collector IC301/pin 5
CC	CC video information Horizontal pulses Vertical pulses	Q305/emitter



VIDEO INPUTS

NOTES



VIDEO PROCESSING BLOCK

CTV25J49 942 8 12 98

Video Output

The video output stage utilizes the parts listed below to produce and control the picture:

Final Parts in the Video Output Stage		
Part	Location	Purpose
Y/C Jungle IC301	Main A board	Separates video into Y & C components when there is no external comb filter. Uses the Y (B&W) signal to adjust the RGB output voltage level. Separates the C input into RGB voltages. Adjusts RGB drive levels to maintain preset cathode current. Req. IK feedback signal.
CRT Amp IC701	C board	Amplifies the RGB drive signal
Picture tube	Front cabinet bezel	Produce a color picture.

Video signal Path

Y/C Jungle IC301

Within Y/C Jungle IC301, the input signal is selected, processed and converted to RGB. The RGB signal undergoes some final processing before leaving the Jungle IC301.

Later Processing Internal to IC301		
Processing Stage	Operation	Purpose
OSD Mixer	The OSD characters replace the RGB signal.	Insert OSD or CC characters into the picture.
Blanking	Uses ABL signal from the FBT to reduce RGB drive voltage. Blank (gnd) the RGB Output signal and instructs IC001 to shut off the TV if there is a ground at IC301/pin 18.	Uses FBT high voltage to limit the brightness of the picture. Excessive FBT voltage or B+ current will cause IC301/pin 18 to be grounded. IC301 informs IC001 to protect the TV by turning the TV OFF.
Gain Control	The gain and level of the RGB signals is set by I^2C communications data (SDA) before output. Picture tube cathode current (IK) feedback is used to maintain RGB levels.	Maintains good white balance.

Video Buffers

These three buffer transistors provide current drive to sink the current from IC701. A short in one of these transistors would stop that color (and activate blanking via the IK circuit). An open transistor will cause that color to go to a high brightness (with retrace lines).

CRT Amplifier

This IC package amplifies the RGB signal from the buffers to a sufficient voltage to drive the cathodes of the picture tube.

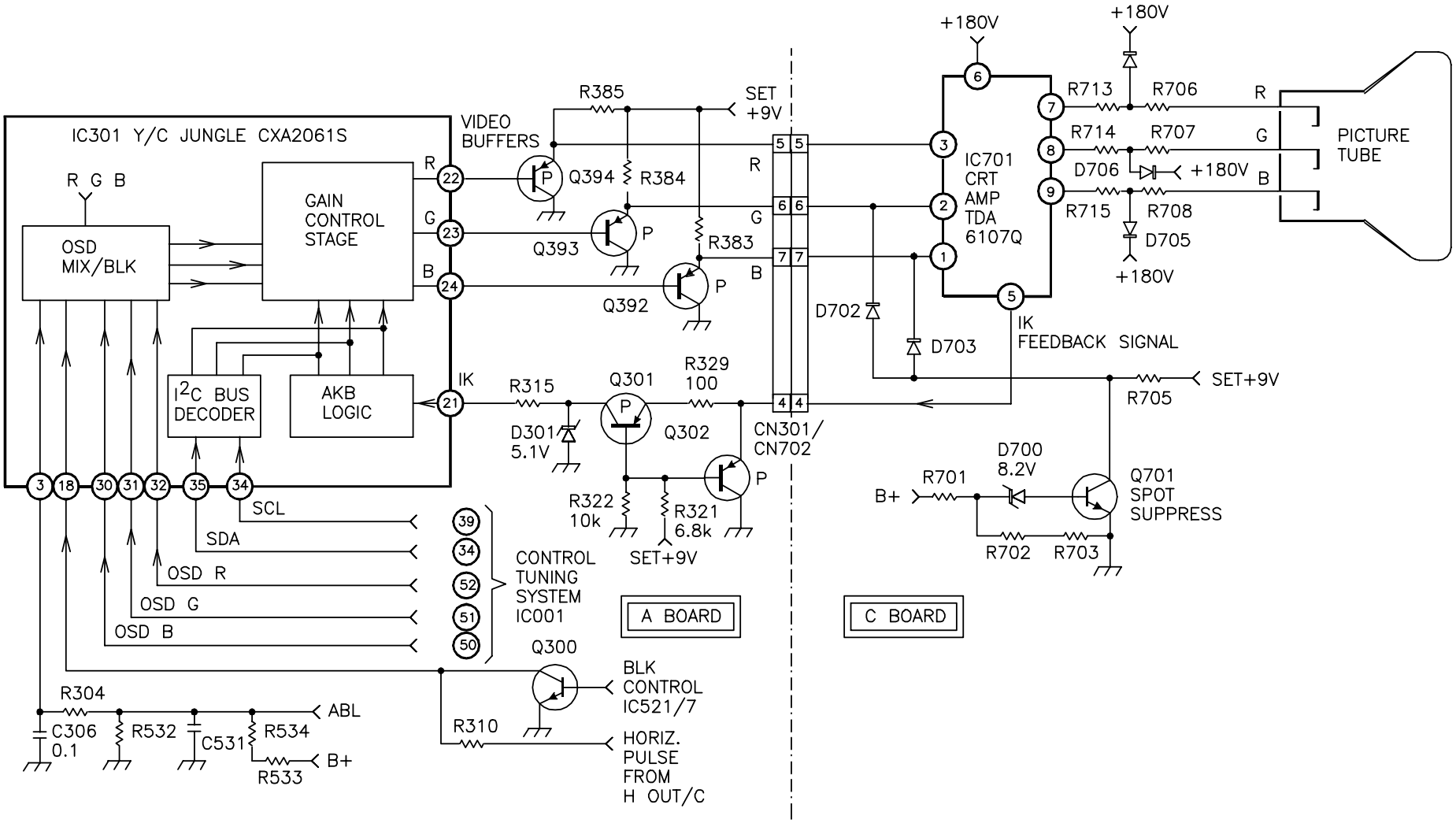
Cathode Current Adjusting (IK) Circuit

Concept

As the picture tube ages, the electron output of the three cathode structures will no longer be the same. The cathode current (IK) circuit monitors the current of each cathode and adjusts the electronic drive signal level to compensate for the differences due to aging. As the tube is being used, normal wear causes the cathodes to decrease in output at different rates. When one cathode has dropped in output below the others, white color no longer appears white. White balance is now “off”. Increasing one of the R, G or B drive signal levels to the deficient cathode increases that cathode’s electron emission so its output will be like the others. The picture quality can be automatically maintained with this circuit.

Circuitry

The automatic cathode current adjusting circuit keeps the video and OSD blanked until the AKB circuit has finished. The Y/C Jungle IC301 generates the cathode drive pulse to begin the IK circuit operation. Three horizontal lines in the vertical interval of the field above the picture are used to test each cathode, one at a time. Each cathode is driven full ON, starting with the Red output at pin 22. After the first pulse at pin 22, IC301/pin 23 sends a 10usec pulse to turn on the green cathode for the entire horizontal line. After the pulse at IC301/pin 23 returns LOW, pin 24 outputs the last pulse to turn on the blue cathode. These 10usec. width positive drive pulses are buffered by Q392-Q394 and amplified by IC701 to be applied to the picture tube cathodes.



VIDEO OUTPUT

CTV25J30 8B3 8 19 98

When the picture tube warms up and draws current, these three pulses all appear next to each other at the common cathode IK pin 5 of IC701. The amplitudes represent the current of each cathode.

Clipper Stage – Q301, Q302.

This IK signal is applied to a signal clipper stage to cut off low and high level parts of the waveform. The clipper circuit consists of a voltage divider and two transistors. The voltage divider resistors R321 and R322 place the base of both transistors at a threshold voltage. The IK signal is applied to both transistors' emitters. When the IK signal rises above this threshold, both transistors conduct and pass only the signal above this voltage threshold. Therefore this stage is said to clip the lower voltage components of the positive IK signal, leaving the just the peaks.

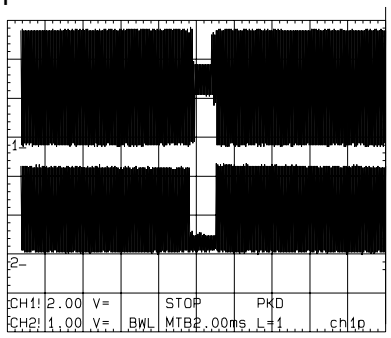
In normal operation, the IK line consists of the three IK pulses and the video signal from the picture tube cathodes. Q301 passes the signal to the Y/C Jungle IC301 so the IK pulses can be identified and used for cathode current balancing. Zener D301 limits the signal input to the Y/C Jungle IC301/pin 21 to a 5-volt maximum pulse.

Q302 is used to clip the larger amplitude signals. Q302 operates similarly to Q301, but passes the IK signal to ground, dividing the signal current. As the signal amplitude becomes larger, more current flows through R329. The additional voltage dropped by R329 turns Q302 ON harder than Q301. As Q302 turns ON harder, the level of the video signal (or any other voltage spike from the picture tube) is reduced so it does not damage the Y/C Jungle IC301.

The following waveforms show the IK signal entering the signal clipper stage (CH 1) and the signal leaving (CH 2). Note that only the top half of the IK waveform is allowed to pass.

CH 1

CH 2



Color bar pattern on TV screen. Digital scope is set for peak waveform presentation. The 3 IK pulses are difficult to see in this digital picture, but are present to the right of the open (vertical) area. The vertical lines in the waveform represent the horizontal scan lines.

Channel 1 – CN301/pin 4; 2v/div.

Channel 2 – D301/Cathode; 1V/div.

Time base = 2msec/div.

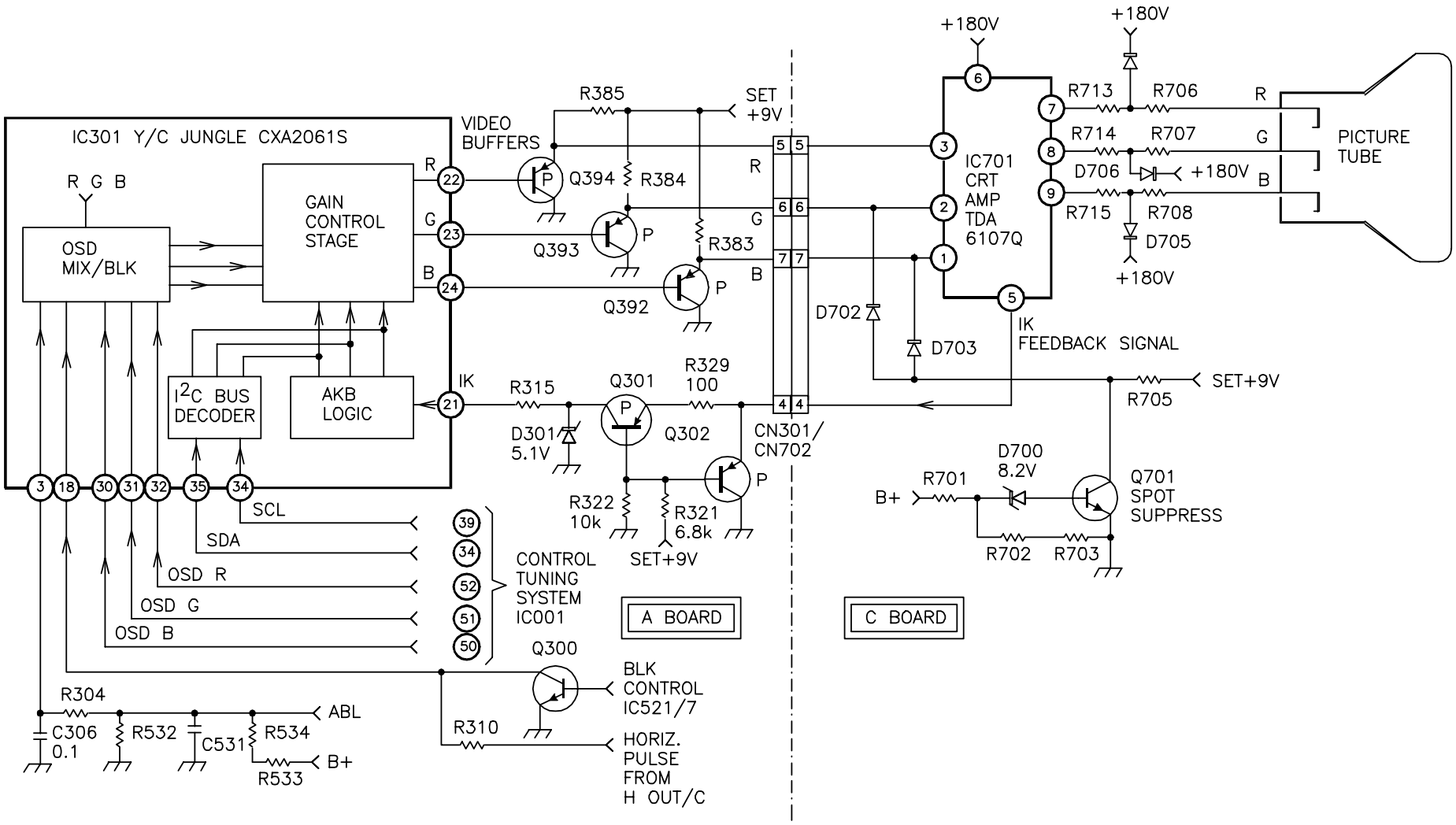
The output IK signal is applied to IC301/pin 21. Inside IC301, each one of the three IK pulses is measured and compared to technician set levels stored in memory. These levels stored in memory are accessed from the service mode (see the service manual). The information is adjusted and used to set the gain of the RGB signals. When the gain is within the automatic adjustment range, the RGB signal is unblanked and leaves IC301 (pins 22-24) with the IK pulses.

Transistor Voltages – Color Bar Test Pattern			
Transistor	Emitter	Base	Collector
Q392	0	1.5Vdc	2.2Vdc
Q393	0	1.5Vdc	2.1Vdc
Q394	0	1.6Vdc	2.2Vdc
Q300	0	0.46Vdc	3.4Vdc
Q301	3.8Vdc	3.73Vdc	0.78Vdc
Q302	3.9Vdc	3.73Vdc	0

Spot Elimination Circuit

Since many cable boxes shut off power by removing AC when the TV is ON, the TV could leave a spot of light at the center of the picture tube. This is because the TV's magnetic deflection would collapse first being the most power hungry, leaving residual beam current to produce a center spot.

Q701, D700, D702, and D703 will drive the CRT harder depleting the beam current when AC is lost. Normally with the TV ON, Q701 is turned ON with bias from B+ via zener D700. Q700's collector voltage is LOW. When AC vanishes, B+ is lost and Q700"s collector voltage rises to apply Set +9Vdc to IC701/pins 1&2 (via diodes). This drives the blue and green beams full ON before deflection ceases, depleting the power providing beam current. The reduced beam current eliminates the possibility having a spot on the screen.



VIDEO OUTPUT

CTV25J30 883 8 19 98

Troubleshooting

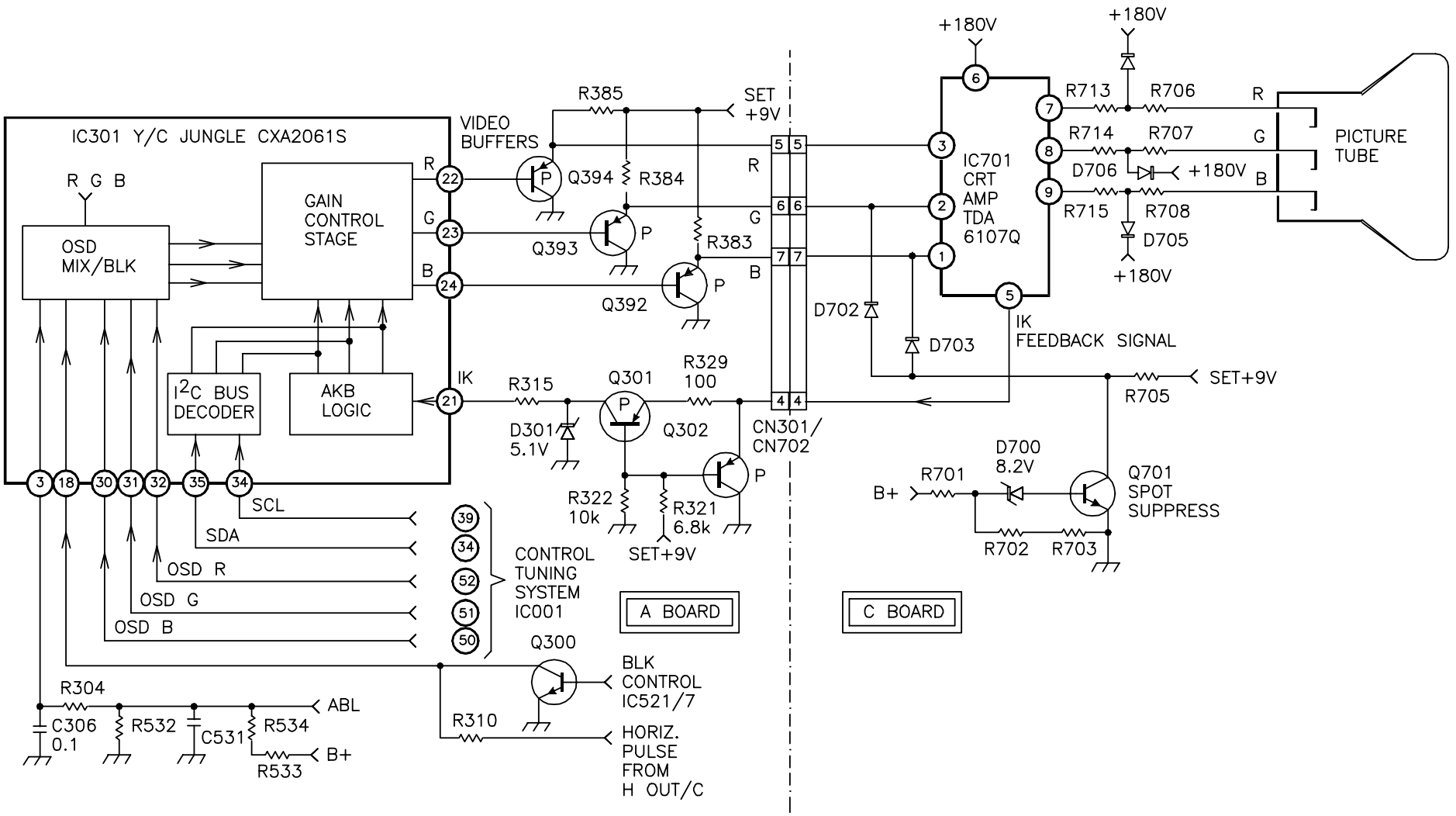
The IK circuit may keep the set in blanking because:

- The picture tube is old and the amplitude of the IK feedback pulses is too low to permit automatic cathode adjustment
- One or more of the IK pulses is not output to the CRT
- One or more of the IK pulses is not returned to the Jungle IC301/pin 21.

Turning up the screen control will permit you to see if a color is missing. If there is a color missing, the problem is between the Jungle IC and the picture tube cathodes.

If all three colors are present, the defect is in the IK return/feedback line between IC701/pin 5 and Jungle IC301/pin 21. While the unit is in blanking, use your scope to look for the three positive IK pulses from the Jungle IC301/pin 22-24 back to pin 21.

IK SIGNAL PATH			
Component	Signal In	Signal Out	Purpose
IC301/pins 22, 23, 24		Positive pulse Blanked Pix. = 3.6Vp-p. IK signal. Normal Pix. - 2Vp-p	Drive the picture tube cathode during the test interval.
Q392-Q394		Same as above.	Buffers.
IC701	Positive pulses Blanked Pix. = 3.2Vp-p. IK pulse + 0.2Vp-p of residual horiz. pulses at the bottom. Normal pix. = 2Vp-p	Pins 7-9: Neg. pulses Blanked Pix. = 180Vp-p IK pulses. Normal Pix. = 180Vp-p of R, G, or B signal with a 120Vp-p IK neg. pulse.	Amplify the 3.2Vp-p IK test signal and 0.2Vp-p horizontal signal to the picture tube.
IC701	Positive pulses Blanked Pix. = 3.2Vp-p. IK pulse + 0.2Vp-p of residual horiz. pulses at the bottom. Normal Pix. = 2Vp-p	Pin 5: Blanked Pix. = 3Vp-p horizontal pulses with a 0.7Vp-p positive IK signal. Normal Pix. = 3.5Vp-p RGB signal with 110Vp-p positive IK signal	Supply a composite RGB output signal at pin 5 to monitoring cathode current
Q301, Q302	Input same as IC701/pin 5.	Output Q301/C Blanked Pix. = 0.4Vp-p of horiz signal with a 0.1Vp-p positive IK pulse. Normal Pix. = 1.5 Vp-p RGB signal with a 0.2 positive IK pulse.	Clip the lower portion of the waveform. Limit the amplitude of the overall signal.
IC301/pin 21	Same as Q301/C (Output)		Extract IK pulses and use them to adjust RGB levels and unblank the video.



VIDEO OUTPUT

CTV25J30 883 8 19 98

Video Block – 27 with PIP

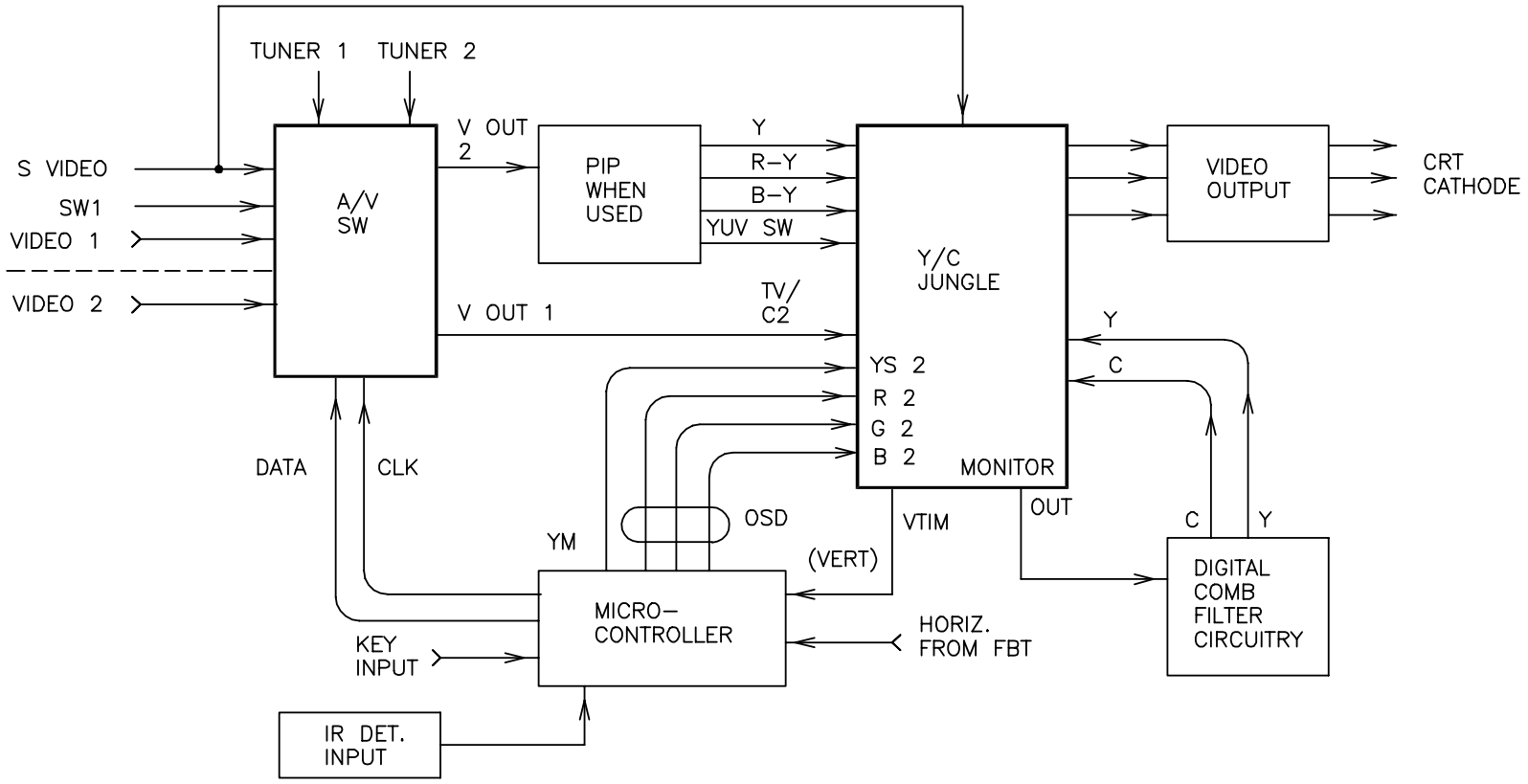
An A/V switch to accommodate the second tuner and the Picture in Picture (PIP) board are the only sections have been added into the 27" BA-4 chassis. The video signal flow is the same as in the 20" BA-4 chassis.

A/V Switcher Inputs / Outputs

Inputs	Outputs
Tuner 1	V 1 is the main picture video to the Jungle IC.
Tuner 2 (optional)	V 2 is the video signal to the PIP board.
Video 1 (Composite or S Video)	
Video 2 (optional)	
Video 3 (optional)	

Picture in Picture (PIP) Board Signal Flow

PIP Board Input / Outputs	
Input	Output
Video 1 from the A/V switcher IC	Luminance (Y), R-Y (V), and B-Y (U).
	PIP insertion signal (YUV)



VIDEO BLOCK – 27" WITH PIP

CTV25J35 888 7 29 98

Picture In Picture Processing

Overview

The purpose of the Picture in Picture circuitry on the small P board is to digitally compress the normal 525 line transmitted picture into a small picture 1/9 its original size. To do this, the PIP processor IC must first take the analog luminance and color information and convert it to digital format. Then, using the vertical and horizontal sync pulses, this IC eliminates information, which makes the picture smaller. The remaining information is then stored into memory. When PIP is called for by the customer, the memory picture is converted from digital back to analog before leaving the PIP Processor IC3303/pins 7-9 as Y, R-Y (V), and B-Y (U).

PIP IC Operations	
IC	Purpose
Chroma Decoder IC3304	Converts incoming video to Y, V, and U. Alters outgoing V & U signals to match the main pix color using SCP (video) from Jungle IC301.
PIP Processor IC3303	Uses H & V to make the pix smaller. Stores the child pix into memory. Analog to Digital for memory storage and reverse to PB.

Most of this child picture processing is done in IC3303, which makes troubleshooting simpler. The other main IC is a chroma decoder, IC3304, that converts the incoming video into Y, R-Y and B-Y for the PIP Processor IC3303.

Processing

The Picture in Picture circuit board needs the following signals to operate. These signals are present all the time when the set is ON, whether the Picture in Picture section is being turned on or not. These signals are:

1) Serial data and clock signal at connector CN302/12 and 13.
2) +9V at CN302/1, which becomes +5Vdc on the board.
3) Input video signal at CN302/2 = 2Vp-p.
4) The P board uses the child pictures sync to sample and store the child picture. The main picture's vertical and horizontal pulses are used to determine where the beam is at any given moment, so the Picture in Picture can be output for main picture insertion at the proper location. These input timing signals are approximately 5Vp-p.

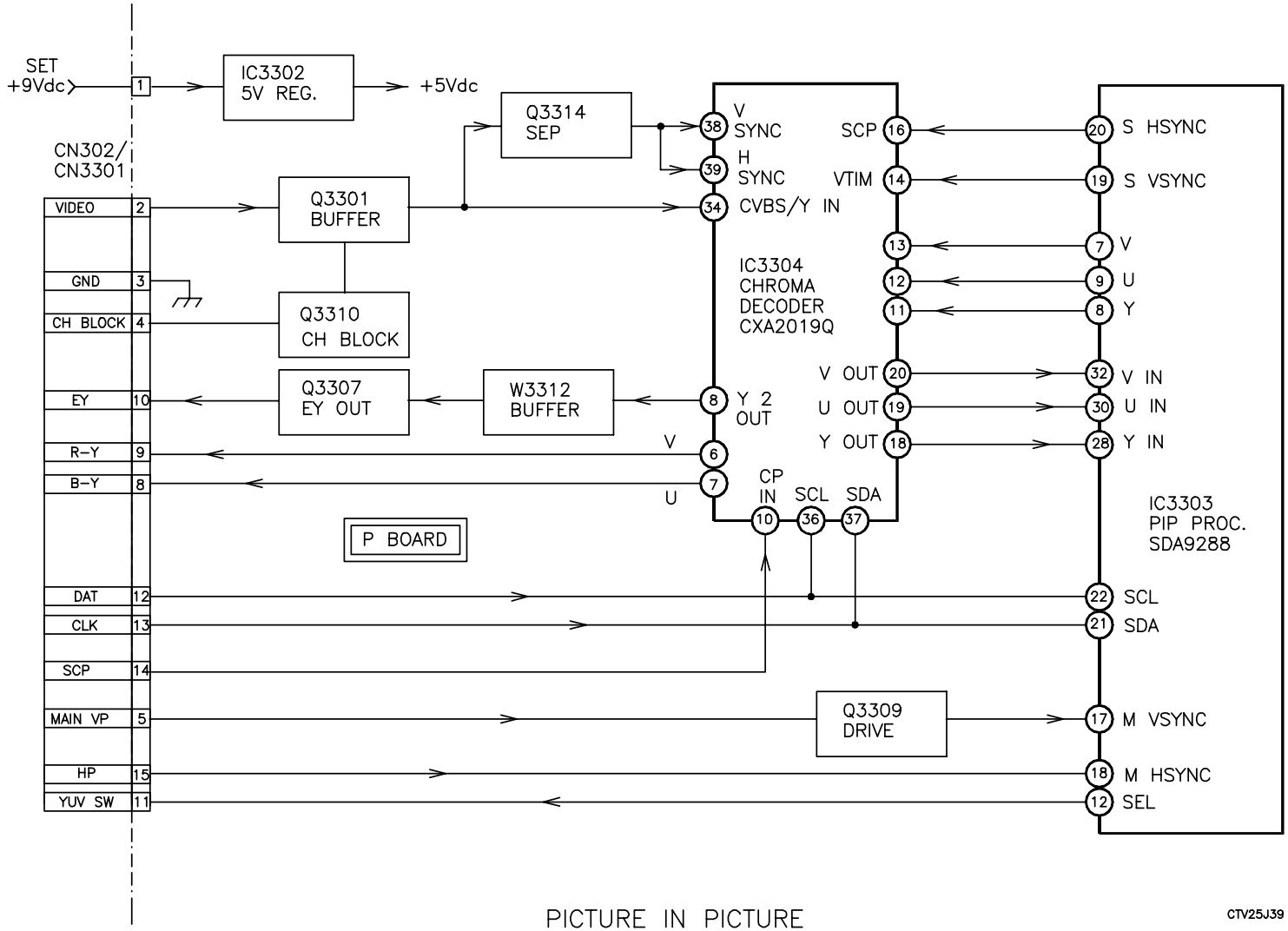
The Y, R-Y and B-Y signals that leave the P board when PIP is turned ON have to be switched into the main picture at the correct time. That is the purpose of the YUV (or PYS in several other sets) signal that is output at pin 17 when the child picture is simultaneously output. This YUV signal to Jungle IC301/36 selects the main picture when LOW and the Picture in Picture when HIGH. Conceptionally, the YUV signal cuts a hole in the picture in which the child picture is inserted.

When Picture in Picture is called for from the remote control, all four Picture in Picture inputs to the Jungle IC301/ 9, 10, 11 and 12 will be active.

Signal Flow

The video or child picture that enters the Picture in Picture board at CN302/ pin 2 is a 2Vp-p video signal that is input to the Chroma Decoder IC3304. IC3304 outputs the video as Y, R-Y and B-Y labeled as Y, V and U at IC3304/18, 19 and 20. (The simpler labeling of Y, V and U in place of Y, R-Y and B-Y has been used in Europe for years.)

The Picture in Picture processor IC3303 outputs child picture information when serial data (SDA, SCL) is input and calls for that feature. At that time, only when PIP is turned ON does the child picture information output from IC3303's Y, V and U output terminals.



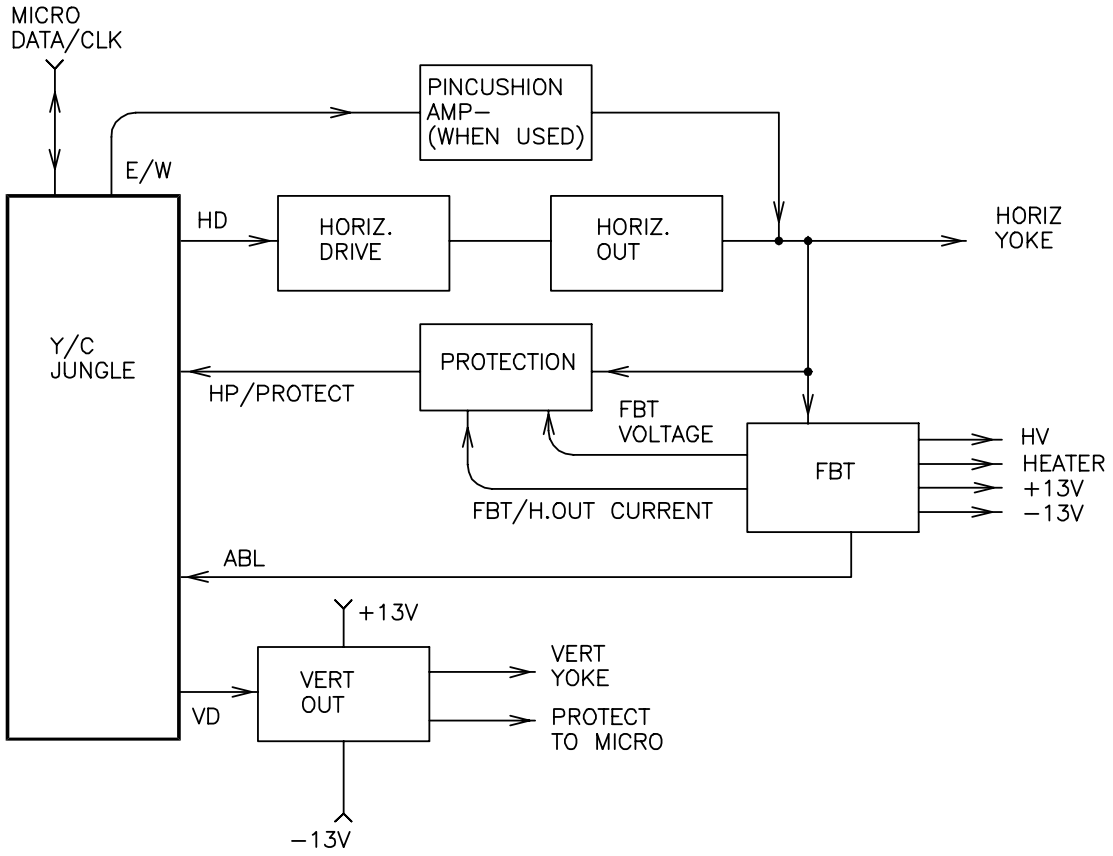
PICTURE IN PICTURE

CTV25J39 892 8 19 98

Deflection Block

There are several sections to a TV's main horizontal and vertical Deflection stage:

Deflection Sections		
Name	Sections	Purpose
Horizontal Output	Y/C Jungle Drive Output	Horiz. oscillator. Horiz. amplifier. Horiz. amplifier to drive the horizontal deflection yoke.
Pincushion	Y/C Jungle (E/W = east/west) Pincushion Amp	Hourglass shaped pictures occur in yoke deflection angles 100^{o} or more. This stage increases width at left and right sides to compensate.
High Voltage	Horiz. Output Flyback Transformer (FBT)	Makes primary drive signal. Develops picture tube accelerating high voltage. Makes remainder of tube and vertical output voltages.
Horiz (HP) AFC / Protection	Horiz Output Resistive Voltage Dividers, Transistors Jungle IC Micro	Compares huge horiz output pulses (HP) and video sync for AFC lock of H. oscillator. Excessive B+ current or FBT voltages are detected by the Jungle IC. Data transmitted to the Micro will shut OFF the TV.
ABL	FBT	Limits picture brightness by using tube current to reduce RGB drive.
Vertical	Jungle IC Vertical Output	Vertical Oscillator. Vertical Amplifier to drive the deflection yoke.



DEFLECTION BLOCK

CTV25J37 890 8 12 98

Vertical Deflection

The vertical deflection stage consists of:

- Vertical oscillator
- Vertical amplifier
- Flyback generator
- Deflection yoke

The purpose of this stage is to manufacture a magnetic field. The magnetic field will bring the electron beam gradually from top to bottom (vertically) and then quickly back to the top (beam retrace) of the screen to start over again.

Vertical Oscillator

When the TV is turned ON, Set +9Vdc appears at Y/C Jungle IC301/pin 44. The internal horizontal oscillator begins and is counted down (divided) to 60 Hz to become the vertical drive signal.

The drive signal is formed into a positive and negative ramp to be changed in amplitude and linearity by the serial data from Micro IC001. If the data or clock signal were missing, there would be NO vertical drive signal output IC301/pins 13 and 14.

Vertical Amplifier

A single package vertical amplifier and output IC541 generates sufficient amplitude and current to drive the deflection yoke. It is powered with ±13Vdc from the flyback transformer secondary.

Flyback / Boost Generator

The vertical waveform is used to generate extra current in the deflection yoke during the retrace period. This extra current is used to quickly return the electron beam to the top of the picture.

The flyback generator stage within IC541 uses the vertical waveform to make a 30Vp-p pulse needed during retrace time. The retrace portion of the vertical drive waveform input IC541/pins 13-14 is extracted, amplified and appears at pin 3 as a 30Vp-p pulse. It passes through C541 to provide sufficient current to power IC541/pin 6 during retrace time. Diode D542 blocks this pulse and prevents it from increasing the +13 volt source.

The vertical flyback signal from IC541/pin 3 is used in the protection circuit. This 30Vp-p signal from pin 3 is reduced to 5Vp-p and monitored by Micro IC001 to prove the vertical stage is working.

Deflection yoke

The deflection yoke translates the electrical current flowing through its coils into a magnetic field that positions the election beam vertically. Current flowing through the deflection yoke coil is returned to ground through R544. The voltage developed across this resistor is fed back to the inverting input of IC541/pin 1 to improve linearity.

Protection

A loss of data, vertical drive, flyback generator signal or ±13Vdc power will cause the protection circuit to shut OFF the TV. The 30Vp-p retrace pulse from IC541/pin 3 is used as an indication of vertical output operation. This pulse is reduced to 5Vp-p and monitored by Micro IC001/pin 17. After two seconds of missing pulses, IC001 will turn OFF the TV set and blink the Timer light four times.

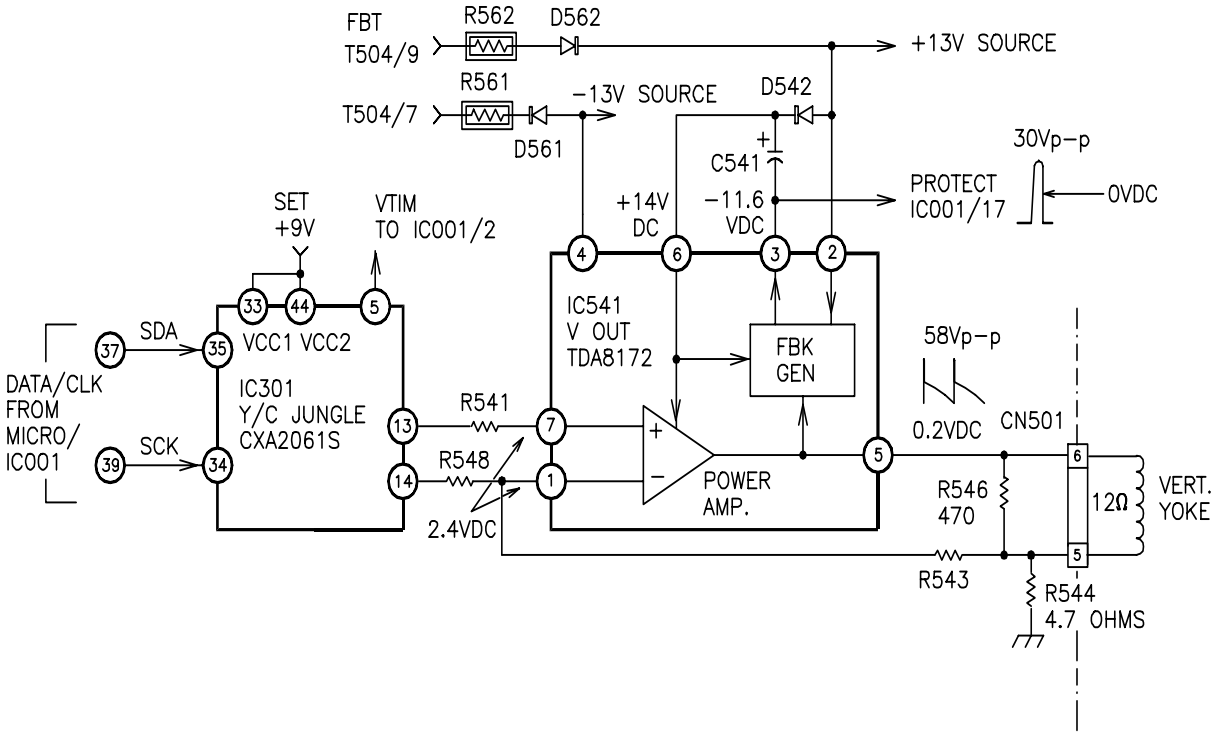
Troubleshooting

When the TV is shutdown and the Timer/Standby light blinks four times, the problem is in the vertical or horizontal section. Start the TV by pressing the Power button. You have two seconds to identify the missing signal with your scope or voltmeter before the TV shuts down again. Here is a general checklist of items that will cause the TV to shutdown:

Some causes for the Timer/Standby light to blink four times and repeat

Some causes for the Timer/Standby light to blink four times and repeat

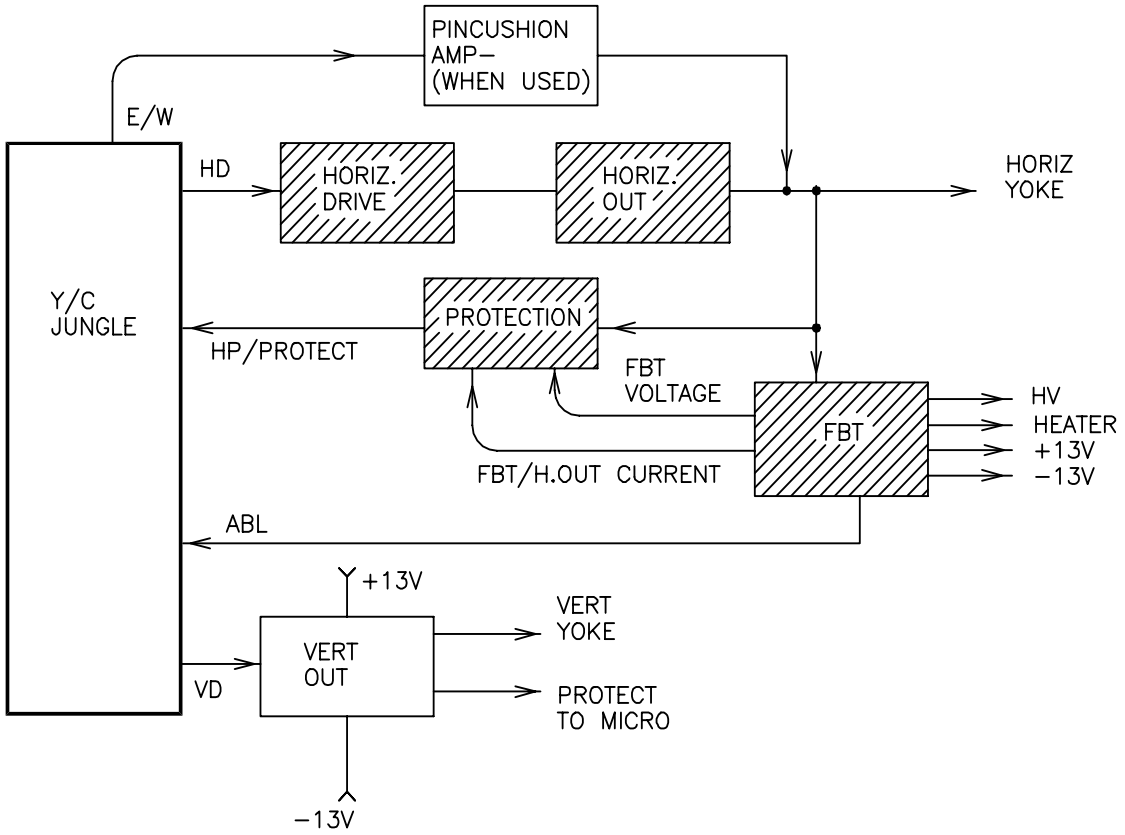
- No Data/Clock input (IC301/pin 34, 35). This causes NO IC301/pins 13-14 drive output.
- Loss of either or both vertical drive signals from IC301/pins 13 and/or 14.
- No fbt/boost output from IC541/pin 3
- Missing positive or negative 13 voltage to power IC541 at pins 2 or 4. This voltage comes from the FBT.
- Loss of horizontal drive resulting in no FBT voltages.



VERTICAL DEFLECTION

CTV25J34 887 8 12 98

NOTES



DEFLECTION BLOCK

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Horizontal Deflection

The horizontal deflection stage consists of several sections:

- Horizontal Oscillator
- Horizontal Drive
- Horizontal Output
- AFC feedback
- Automatic Brightness Limiting (ABL)
- Protection

Horizontal Oscillator

When the TV is turned ON, Set +9Vdc appears and is applied to Y/C Jungle IC301/pin 33. Internally, IC301's horizontal oscillator starts and shapes this signal into a horizontal drive pulse that leaves pin 19. The pulse is 4Vp-p with a positive width of 24usec. The waveform stays LOW for 40usec. after the pulse and repeats.

Horizontal Drive

The horizontal signal from IC301 is amplified by IC501. The signal levels are shown in the following chart:

Horizontal Drive		
Location	Amplitude	Vdc
IC301/pin 19	4Vp-p	3Vdc
Q501/base	3Vp-p	0.7Vdc
Q501/collector	100Vp-p	47Vdc
Q502/base	2Vp-p (6Vp-p w spikes)	0.03Vdc

In the KV20M40 model TV, Q501 amplifies the horizontal drive signal to 100Vp-p (B+ = +116Vdc). The drive signal is reduced in voltage, but increased in current by T501. The increased current at the secondary is necessary to drive the low gain, higher power and horizontal output transistor Q502.

Horizontal Output

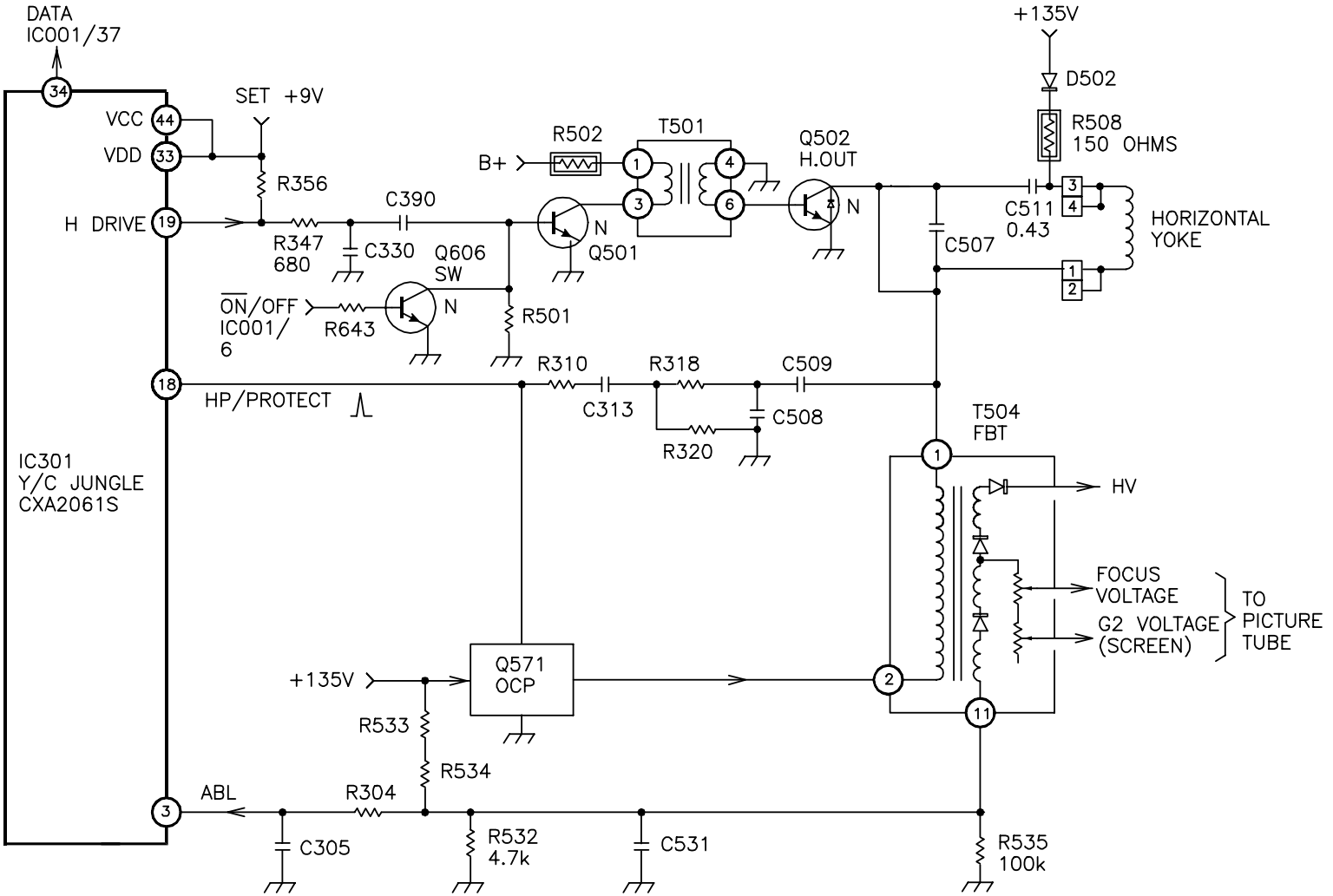
Q502 is the output transistor that drives two inductive loads and two circuits:

- The deflection yoke – Develops a magnetic field in order to move the electron beam from left to right on the screen.
- The flyback transformer – Develops high, focus, screen and $\pm$13Volts for the picture tube and TV's vertical section.
- AFC feedback circuit – Used to monitor the frequency of the horizontal oscillator.

AFC feedback

A sample of the horizontal output signal from Q502/collector is used to keep the horizontal oscillator locked to the incoming video sync. The high voltage pulse at Q502/collector is reduced by voltage divider C509 and C508 to 23Vp-p and again by R318 and R320 to 5Vp-p. The 5Vp-p signal passes through C313 and R310 to IC301/pin 18.

Inside IC301, this horizontal output signal is compared to the incoming video sync and a correction voltage is developed. The correction voltage is used to keep the frequency of the Jungle's horizontal oscillator in step with the incoming video. This is the automatic horizontal frequency correction (AFC).



HORIZONTAL DEFLECTION /HV

CTV25J32 885 8 12 98

Automatic Brightness Limiting (ABL)

The purpose of this circuit is to prevent sudden bright scenes from shortening the life of the picture tube. It does this automatically by monitoring the picture tube's current and then using this voltage to limit the brightness of the picture.

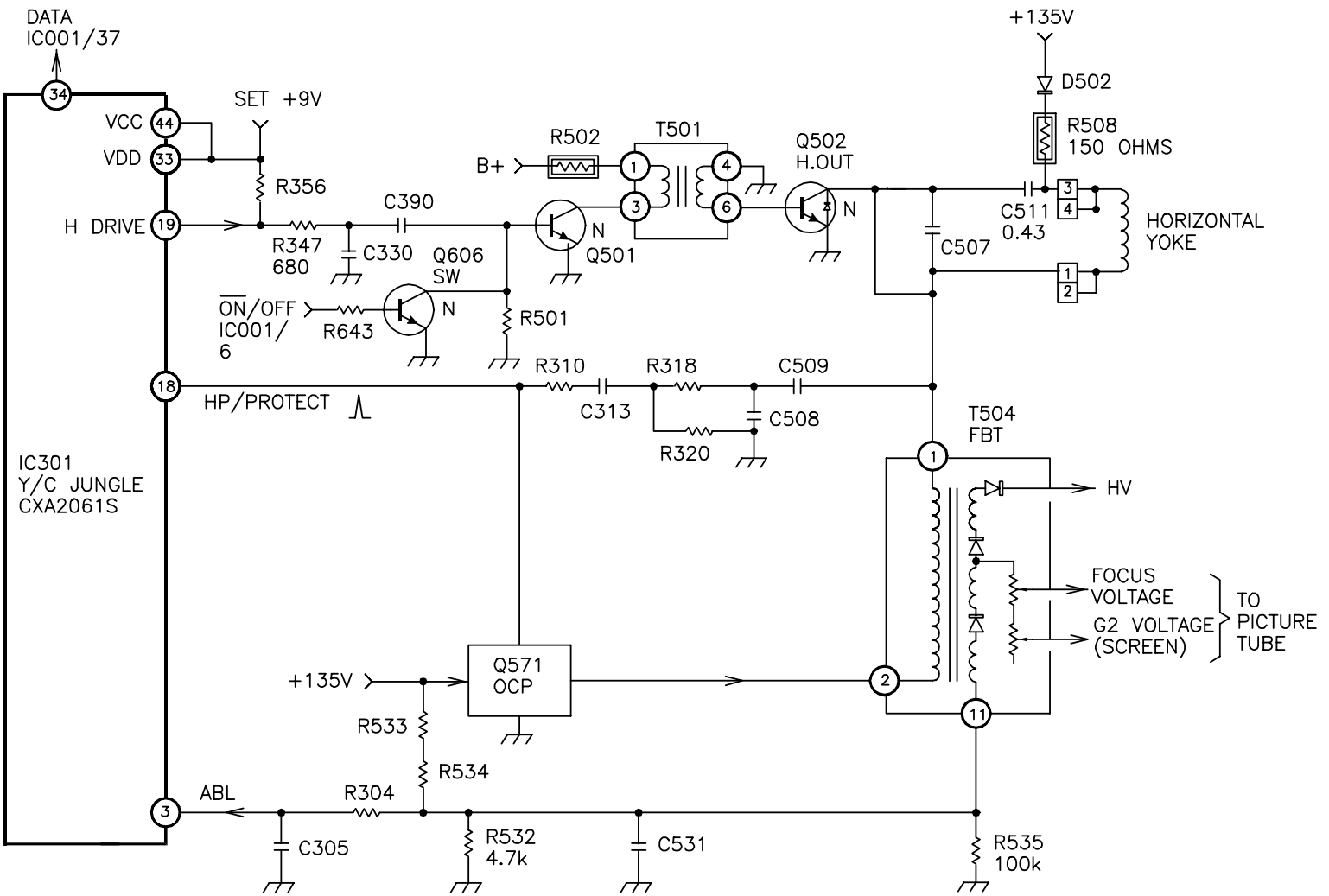
The flyback transformer T504 (secondary) supplies the picture tube's high voltage. The ground end of the secondary at T504/pin 11 is current limited by a 100k ohm resistor, R535. As the picture gets brighter, the high voltage current increases, causing a voltage drop across R535. This ABL voltage decreases with increasing brightness.

ABL Voltages –Model KV20M40		
Condition	T504/pin 11 Voltage	IC301/pin 3 Voltage
Black screen (generator)	6.2Vdc	6.2Vdc
Color bars	2.96Vdc	3Vdc
White screen	2.1Vdc	2.1Vdc

Voltage divider R533, R534 and R532 bias this ABL line with a positive voltage that is applied to Jungle IC301/pin 3. A lower ABL voltage decreases the level and gain of the RGB waveform. This is how ABL section uses the Jungle IC to keep the brightness within a reasonable operating range.

OCP Protection

One part of the protection circuit is shown here in block form. The over current Protection (OCP) stage shuts OFF the TV during a fault. Q571 is used to monitor the current flowing through the FBT and horizontal output transistor. If the current becomes excessive, Q571 conducts, grounding out the DC voltage from the Jungle IC301/pin 18. This ground causes IC301/pin 34 to send data to Micro IC001/pin 37. The data instructs IC001 to shut OFF the TV, allowing the horizontal output transistor to cool down.



HORIZONTAL DEFLECTION /HV

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Protection

The TV's protection circuitry either blanks the video or turns the TV OFF. Protection can be caused by a failure in one of these stages:

Failures Activating TV Protection	
Picture Blanking (sound OK)	Shutdown - TV = OFF
1. Loss of R, G, or B drives from IC301	1. Vertical Failure - loss of boost pulse from IC541/pin 3).
2. Ik signal from C board missing pulses	2. Horizontal drive failure stops powering the FBT. The FBT stops powering vertical IC541.
3. Screen control misadjusted	3. Excessive FBT secondary voltage
4. Picture tube weak	4. Excessive B+ current to FBT and/or H. Output transistor.
5. ABL voltage to IC301/pin 3 missing	

The picture blanking protection was explained in the video output document of this training manual.

The remaining protection circuits shut the TV OFF. They are shown here controlled by Micro IC001. There are only three circuits that tell IC001 to turn OFF the TV:

Protection Circuits that turn the TV OFF		
Defective Stage	Trigger Mechanism	IC001 Input
Vertical Output	Missing vertical pulses.	Loss of V pulses for 2 seconds at pin 17.
FBT Output	Excessive output voltage	Data into pin 37
B+	Excessive current	Data into pin 37

Vertical Output Failure

Pulses from the vertical output IC are monitored for activity by IC001. Two signals are output when the vertical output stage is receiving the drive signal and amplifying. The main drive signal goes to the vertical deflection yoke. The other signal is made inside the vertical Output IC541's flyback generator and output pin 3. At pin 3 is a 30Vp-p pulse that is reduced by R549 and limited by zener diode D001 to 5Vp-p. IC001/pin 17 receives and monitors this 5-volt vertical pulse to prove the Vertical stage is operating.

If IC001 detects a loss of these vertical flyback pulses for two seconds, IC001 will turn the TV OFF. As part of IC001's diagnostic program, after the set is turned OFF (but not unplugged), the Timer/Standby light will blink four times, pause and repeat. This indicates the problem is a loss of vertical signal.

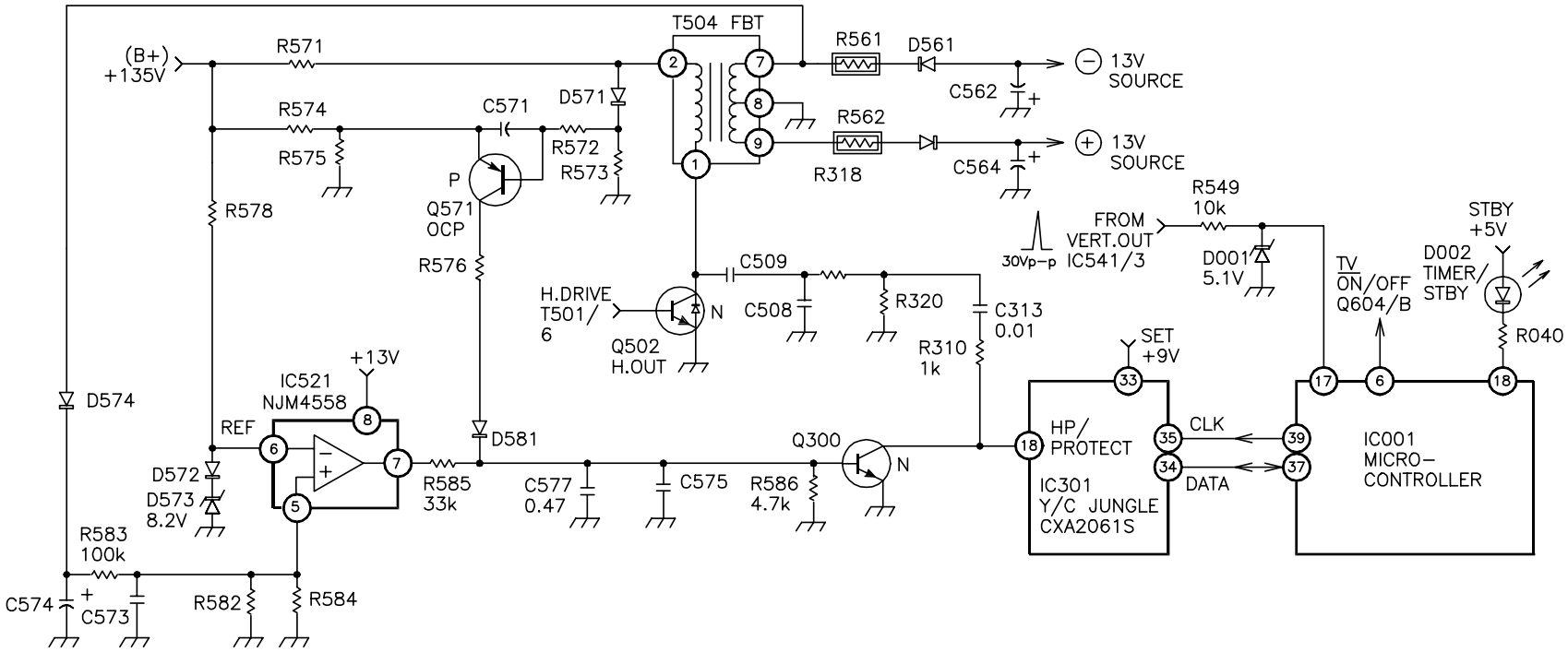
Unfortunately, ±13Vdc that powers the vertical IC541 comes from the horizontal stage (FBT). Therefore, a horizontal failure will also cause the light to blink four times, pause and repeat.

Excessive FBT Voltage

An open safety capacitor C508 or high B+ voltage can cause the flyback transformer (FBT) to produce an undesirably high secondary voltage. The FBT's secondary voltage at T504/pin 7 is monitored for excessive signal level.

This stage consists of T504, D574, IC521, Q300, IC301 and IC001. Flyback pulses are rectified and compared to a reference voltage to determine if they are excessive. The 120Vp-p T504/pin 7 pluses are rectified by D574 into 109.2Vdc. This voltage is reduced further to 8.76Vdc by voltage divider resistors R583, R582 and R584 and applied to the + input of comparator IC521/pin 5. As long as the voltage at pin 5 is no higher than the 9.7Vdc at the negative input pin 6, the output of IC521/pin 7 will remain LOW (1.34Vdc).

The Jungle IC detects the comparator output. The LOW from comparator IC521/pin 7 is applied to Q300/base, keeping it OFF as if it were not in the circuit. This allows the horizontal pulses from Q502/collector and the internal voltage of 3.4Vdc to remain at Jungle IC301/pin 18 for normal operation.



PROTECTION

CTV25J31 884 8 12 98

Normal Operating Voltages		
Component	Input	Output
D574	120Vp-p at anode	109.2Vdc at cathode
IC521	Pin 6 = 9.7Vdc Pin 5 = 8.76Vdc	Pin 7 = 1.34Vdc
Q300	Base = 0.46Vdc	Collector = 3.4Vdc 5Vp-p; 9usec pulse.
Q571	B-E voltage = 0.52Vdc	Collector = 7.9Vdc
D581	0.88Vdc at anode	0.46Vdc at cathode

When the FBT voltage is excessive, the TV is required to shutdown. An excessive FBT voltage level will cause IC521/pin 7 to output a HIGH, which will turn ON Q300. When Q300 saturates, the 3.4volts from IC301/pin 18 are grounded. This ground immediately causes shutdown data to output IC301/pin 35 to the Micro. The Micro receives this command and produces a HIGH at pin 6 to shut off the TV. After the TV is shut OFF, the Timer/Standby light blinks two times, pauses and repeats for as long as the set is plugged into 120Vac.

Excessive B+ current Failure

Leakage in the Horizontal output transistor Q502, shorts in flyback transformer T504 or a short in a secondary winding would draw excessive current from the B+ line. Excessive current drain will cause the TV to shut down, allowing itself to cool off.

Components involved in this stage are R571, Q571, Q300, IC301 and IC001. All the current from the B+ source flows through resistor R571. Transistor Q571's emitter-base junction is essentially placed across this resistor. Resistors R574, R575, R572, and R573 pre-bias Q571. C571 across Q571/b-e prevents rapid scene changes from turning Q571 ON and triggering the protection circuit.

If R571 drops sufficient voltage to turn ON Q571, its conduction will apply a positive voltage through D581 into the base of Q300, turning it ON as well. When Q300 turns ON, the 3.4Vdc from IC301/pin 18 is grounded out. This causes IC301 to send shutdown data from pin 34 to IC001/pin 37. IC001 responds by shutting OFF the TV set when pin 6 is brought HIGH. After the TV is shutdown, the Timer/Standby light blinks two times, pauses and repeats for as long as the set is plugged into 120Vac.

Troubleshooting

The self-diagnostic part of Micro IC001 causes the Timer / Standby light to blink, identifying a problem area. This can be used as an aid in troubleshooting.

Timer / Standby Light

During a failure that causes the TV to shutdown or go into blanking, the Timer / Standby light D002 blinks, pauses and blinks again. The number of times it blinks identifies the defective stage:

Standby / Timer Light Diagnosis		
Standby Light Blinks	TV Symptom	Problem Circuits
2 times, pauses and repeats.	Shutdown. TV powers OFF.	Excessive B+ current demand or high FBT pulse amplitudes.
4 times, pauses and repeats.	Set Turns OFF.	Vertical Failure (may also be Horizontal Failure since the vertical IC is powered by the FBT.)
5 times, pauses and repeats.	1. Raster, but no video 2. Sound OK.	White balance failure, weak picture tube or Low G2 voltage.
Continues to blink once a second.	No or defective Jungle IC301 communications.	No reply from an IC (data bus is busy - grounded or held HIGH).

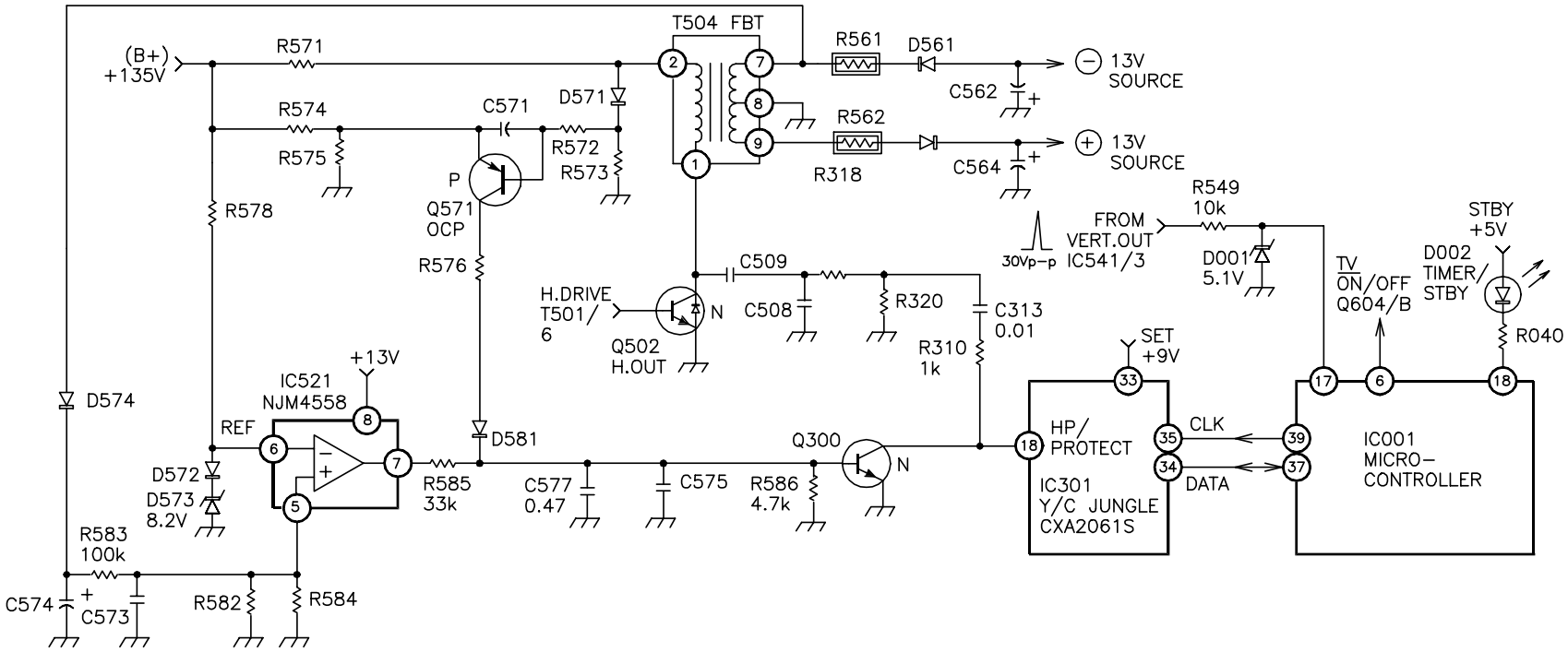
Use the Timer / Standby light to begin your troubleshooting.

Timer / Standby light – blinks two times

The TV is shutting down because there is an excessive current drawn by the Horizontal Output Transformer or Transistor. After checking for shorts in these stages, test the protection trip circuitry.

Testing the Protection Circuitry

1. Locate Q300/base. The collector lead of this surface mount transistor is by itself. If the collector is pointed up, the base lead is at the left.
2. Monitor the DC voltage with a DVM (peak reading is preferred).
3. Turn ON the TV.



PROTECTION

CTV25J31 884 8 12 98

4. The normal voltage should be less than 0.5Vdc. If it is less than 0.5Vdc before the TV turns OFF again, there is a problem in the protection circuit at Q300 or IC301.
   Test Q300 for leakage or replace.
   Move your DVM probe to IC301/pin 18 and turn ON the TV. If this voltage stays below 2Vdc, Q300 is leaky. If above 2Vdc, IC301 may be defective.
5. If the voltage at Q300's base is HIGHER than 0.5Vdc, the problem may be in IC521, Q571, or in the circuitry.
6. Place your DVM at IC521/pin 7 and turn ON the TV. The normal voltage should be less than 2Vdc. If it is higher, the problem is around IC521 or there is excessive FBT voltage from an open safety capacitor (C508) or high B+ voltage.
   Reduce the AC voltage and monitor the voltages at IC521/pins 5 & 6. The voltage at IC521/pin 6 is fixed at the D573 zener voltage plus 0.6V (D572). The normal voltage at pin 5 should never exceed 10Vdc.
   If the voltage at IC521/pin 5 is HIGHER than 10Vdc, the problem is in the circuit's safety capacitor or high B+ voltage.
   If the voltage at IC521/pin 5 is Lower than 10Vdc, the problem is about IC521.
7. If none of the voltages around IC521 were high, the problem must be around Q571, a defective horizontal output transistor or transformer.
8. Place your DVM at Q571/collector. Turn the TV ON. This voltage should not rise above 10Vdc.
   If this voltage is HIGH, suspect Q571, R571 and other resistors in the area.
   If these protection parts test OK, there is a heavy current demand on the B+ line. The problem may be a short at the FBT secondary windings.

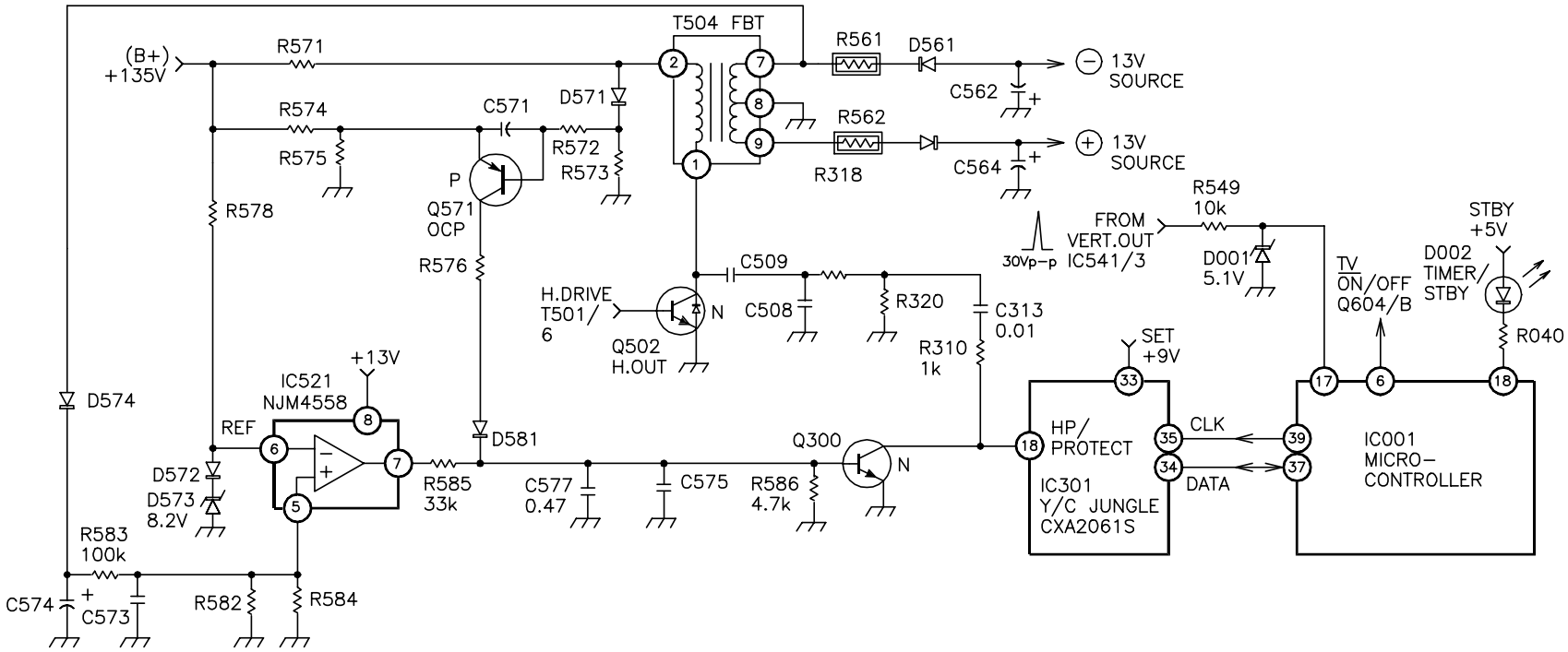
Timer / Standby light – blinks four times

A vertical deflection failure or horizontal drive failure is indicated.

1. Test the horizontal section by using one of these tricks:
   - Place your scope probe by the FBT and turn ON the TV. You will see the horizontal signal if the drive path from the Jungle IC to the FBT is OK
   - Listening to the frying sound at the yoke is another indicator of horizontal signal arriving at the yoke
2. Test the vertical stage by using the scope probe to monitor the vertical drive signal and the DVM to measure the positive and negative supply voltages to the vertical IC541 at turn ON.
3. Test the Protection circuitry by placing your scope lead at the Vertical Output IC541/pin 3. You should see a 30Vp-p pulse there. If it is present, this pulse is not getting to IC001/pin 17. Replace zener D001 if shorted.

Timer / Standby light – blinks five times

This failure is caused by a problem in the video output IK circuit. Turning up the screen control will let you see light on the screen so you can make an evaluation of the problem. For more details see the Video Output section of this training manual.



PROTECTION

CTV25J31 884 8 12 98

Self Diagnostic

Self-Diagnostic is new in the series BA-4 TV chassis. It uses a blinking light or OSD to notify you if there is a failure caused by the following:

1. Excessive flyback current or amplitude;
2. No Vertical sweep; or
3. No green automatic white balancing signal.

Timer / Standby Light

The number of times the Timer/Standby light blinks indicates what failure is detected by the Control Tuning System Microprocessor IC001. IC001 will shut off or blank the TV set to protect itself. The Standby/Timer light will continue to blink as long as the TV is plugged into AC power.

Standby / Timer Light Diagnosis		
Standby Light Blinks	Symptom	Problem
2 times, pauses and repeats.	Shutdown. TV powers OFF.	1. Excessive B+ current demand or high FBT pulse amplitudes. 2. No reply from Jungle IC301.
4 times, pauses and repeats.	Set Turns OFF.	Vertical Failure (may also be Horizontal Failure since the vertical IC is powered by the FBT.)
5 times, pauses and repeats.	1. Raster, but no video 2. Sound OK.	White balance failure, weak picture tube or Low G2 voltage.
Continues to blink once a second.	No or defective Jungle IC301 communications.	No reply from an IC (data bus is busy, grounded or held HIGH).

The number of times the TV has failed is held in memory. As long as there is failure information present, the standby light will blink when the set is tuned OFF. Unplugging the TV set will clear the memory information and stop the blinking.

Self-Diagnostic On Screen Display

A dormant intermittent problem is difficult to detect. The BA-4 chassis Control Tuning System IC001 has a program to record the number of times the TV has failed in the first three categories listed above. This information can be accessed and displayed on the TV screen as long as the set remains plugged in.

Self-Diagnostic Access

With the set OFF, aim the remote at the TV and press the following remote buttons in this sequence:

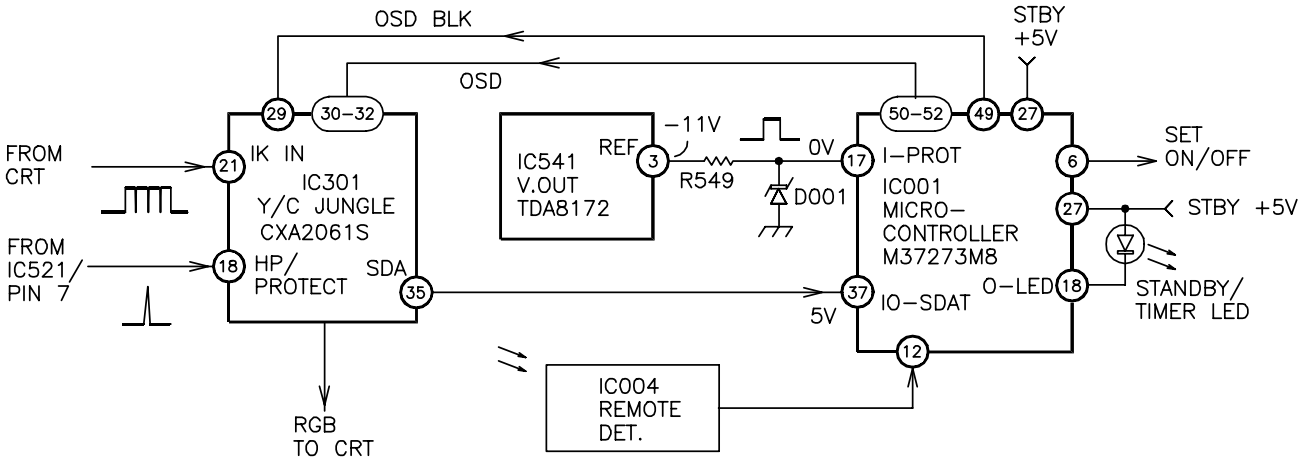
1. Display
2. 5
3. Volume Down -
4. Power On

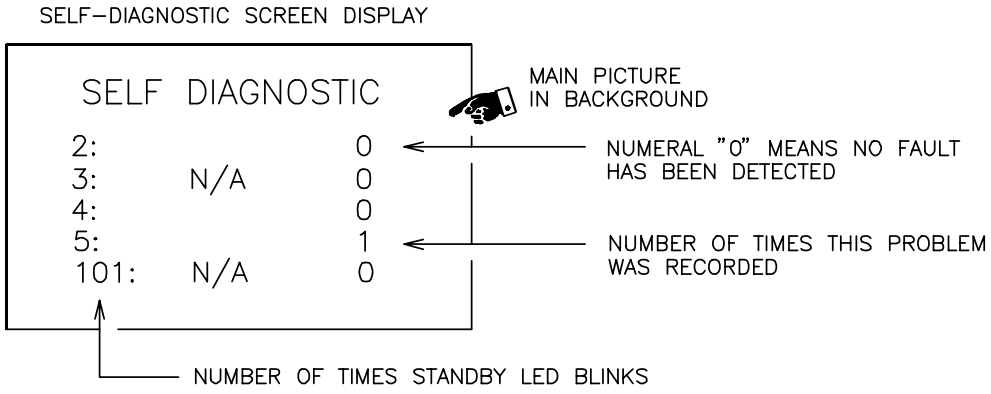
The TV will power ON and display the self-diagnostic page. This self-diagnostic display will overlay the TV or video picture.

At the left of the self-diagnostic TV screen display are the numbers 2, 4 and 5. These represent the number of times the Timer/Standby light was blinking. The numbers 3 and 101 are not used (N/A).

The column on the right side shows the number of failures that have occurred since the program was reset. Up to 99 failures can be recorded.

Although the self-diagnostic page will display the number of times a failure has occurred, it will not be able to tell you exactly where the problem is, only that it exists.





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Some of the reasons for the failure could be in this checklist.

Failure Checklist	
Times Standby Light Blinks	Possible defect
2 (Excessive current or FBT amplitude)	1. Horizontal Output Transistor leaky/shorted. 2. Flyback shorted. 3. Flyback secondary load is shorted. 4. Safety/resonate capacitor opens (C508 in this set). 5. Sensing circuit defect (IC521, Q571 and Q300). 6. No reply from Jungle IC301.
4 (Vertical failure)	1. Vertical Output IC541 failure. 2. Open R549/open foil path. 3. Shorted D549. 4. IC001 damaged by open D001. 5. No vertical drive from IC301/pin 13 and 14. 6. No vertical IC541 +13Vdc power from FBT (horiz drive failure).
5 (Loss of green IK signal to IC301/pin 21)	• Green buffer transistor Q393 open or shorted. • Protection diode D706 shorted. • CRT amp IC701 defective. • Picture tube socket not making contact. • IK amplitude limiter Q302 or zener D302 damaged by picture tube arcing.
Once a second	Jungle IC communications failure.

When the problem is intermittent, you will have to probe further by monitoring the horizontal output transistor temperature and the TV's current consumption to see if it is high, vibrate and possibly "bake" the set to force the intermittent failure to reveal itself.

Memory Clear:
Unplugging the TV from AC power resets the stored failure information and stops the blinking light. The memory is cleared once standby +5Vdc is removed from the Control Tuning System Microprocessor IC001. It can also be manually cleared by first pressing 8 and then pressing ENTER while you are in the self-diagnostic mode.

Clearing the Self-Diagnostic Memory	
Method	Steps
A. Unplug the TV from AC.	Removing AC power clears the memory at any time.
B. From the remote control.	Press buttons: **8,** then press **ENTER**.

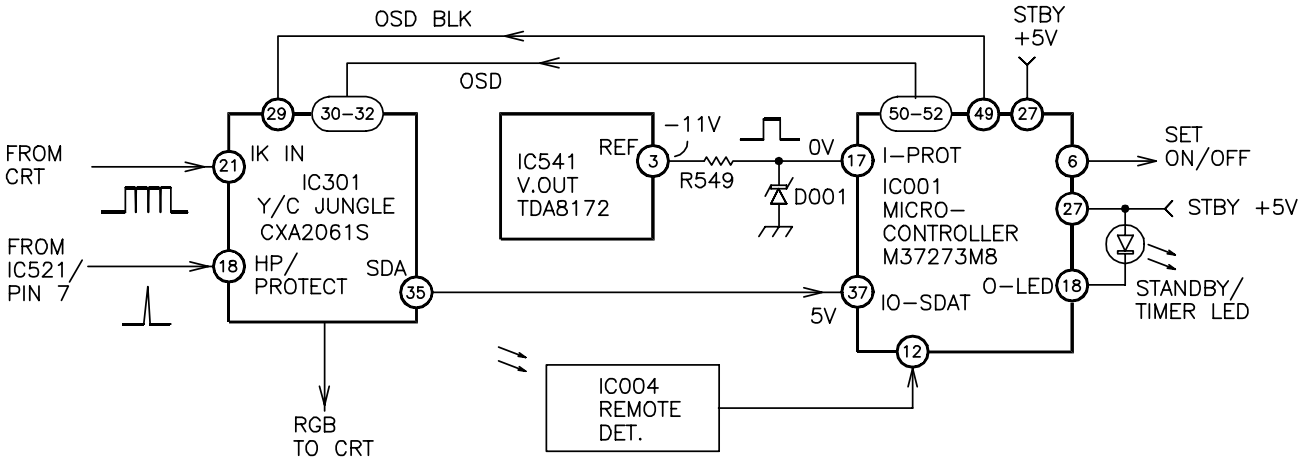
Self Diagnostic Exit:
Shutting off power to the set retains the memory information and allows you to return to the TV picture.

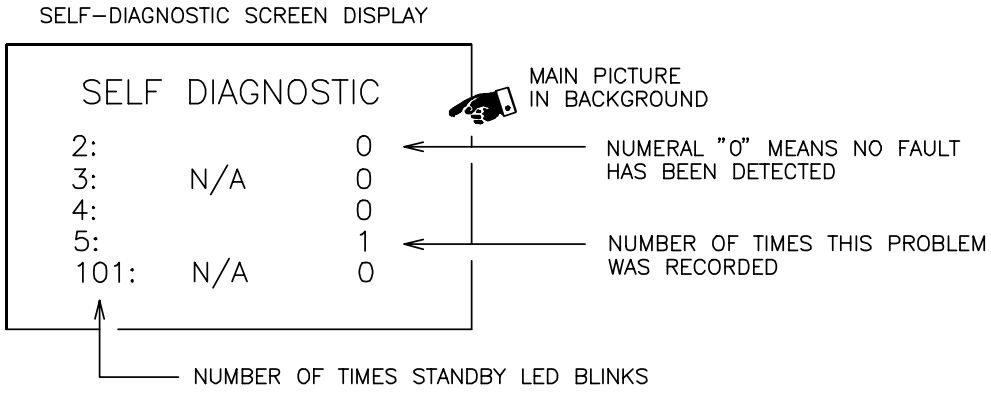
Self Diagnostic Circuit

The self-diagnostic program is contained in the Control Tuning System IC001. The number of problems is detected by the program is stored in IC001. This number remains in IC001's resident memory as long as the TV remains plugged into AC and is not manually cleared.

Inputs
When the TV set is turned ON, IC001 monitors three TV conditions using two inputs at pins 37 and 17. These TV conditions are:

1. Vertical Failure - In normal operation, Vertical Output IC541's "Ref" pin 3 outputs a 30Vp-p pulse (1msec pulse width). This voltage is reduced by R549 and clamped to no higher than 5Vp-p by D001. These vertical pulses from IC541/pin 3 are monitored by Control Tuning System IC001 at pin 17.
   A vertical drive failure causes no pulses to be generated. If these vertical pulses are lost for two seconds, IC001 will turn OFF the TV to prevent the vertical deflection failure from damaging the CRT. However, the front panel Timer/Standby light continues to blink four times, pauses and repeats, even though the set is OFF.
2. Excessive Current Demand/Excessive FBT pulse amplitude – Y/C Jungle IC301 monitors both of these conditions at input pin 18. Normally there are horizontal pulses applied to IC301/pin 18 when the TV is ON.
   When there is excessive current being drawn by the FBT or Horizontal Output Transistor, the horizontal pulses are grounded out. The Y/C Jungle IC301 detects this loss from pin 18 almost immediately and sends data from IC301/pin 35 to IC001/pin 37 (even in normal operation, there is always data on this line). IC001 shuts OFF the TV to





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protect itself. The Timer/Standby light blinks two times, pauses and repeats to indicate the failure.

If flyback (FBT) pulses were abnormally high, perhaps as a result of an open resonate capacitor (C508 in this set), the TV would similarly shut down. Higher than normal FBT pulses result in a high DC voltage that also grounds the horizontal pulses at IC301/pin 18. The loss of horizontal pulses is detected and data is sent from IC301/pin 35 to IC001/pin 37 for the TV to shut OFF. The Timer/Standby light continues to blink two times, pauses and repeats after the failure.

3. White Balance Failure – Jungle IC301 initiates CRT drive and monitors CRT cathode current at pin 21. The amplitude of the three IK pulses that return to IC301/pin 21 represent the level of red, green and blue CRT cathode emissions. Their amplitudes are used to white balance the picture while the TV is ON.

   This IK circuit is designed to look for three IK pulses returned from the picture tube. If IC301 detects a missing IK pulse within two seconds after the set is turned ON, the video is blanked (muted). The two seconds allow time for the picture tube to warm up.

   This blanking state is relayed as data from IC301/pin 35 to IC001/pin 37. IC001 causes the Timer/Standby light to blink five times, pause and repeat. The set remains ON during this video failure, so the sound is still present.

When there are multiple failures, the two blinking light failure has a higher priority over the four blinking light failure. By the same logic, the four blinking light failure has a greater priority than the five blinking light failure. For example, if multiple failures caused all of the two, four and five blinking light failures to be stored in memory, the Timer/Standby light would blink two times, pause and repeat when the TV shut down. The number of failures has nothing to do with how many times the light blinks.

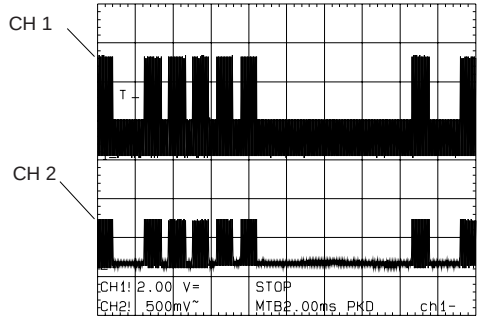
Display

By using the TV's remote control, you can access this failure information stored in memory. Once IC001 receives the self-diagnostic access command at pin 12, IC001 powers ON the TV. The failure information from IC001 is sent to the Jungle IC301 as On Screen Display (OSD) video levels.

A "OSD Blk" signal accompanies the OSD video levels from IC001 into IC301. This analog input voltage at Jungle IC301/pin 29 is used to darken (blank) the main RGB picture signal at the instant the OSD character is to appear and enable the OSD. Since IC301/pin 29 is an analog input, 0Vdc input leaves the main picture at normal brightness. 2Vdc input reduces the picture to half brightness and 5Vdc blanks or mutes the picture.

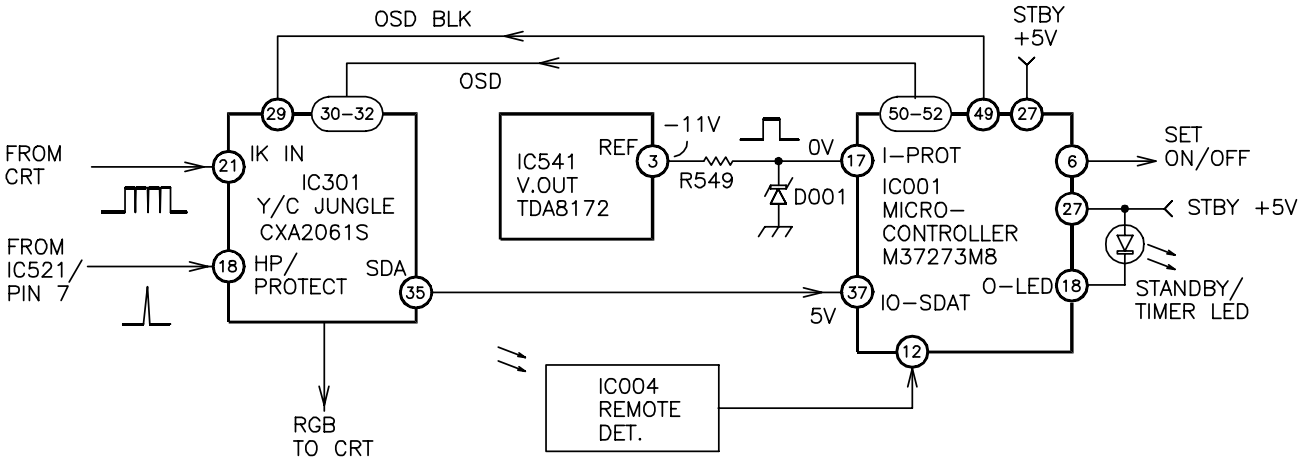
Main Picture Brightness Control with OSD	
Voltage at IC301/pin 29	Brightness level
0 Vdc	Normal
2Vdc	Reduced to half
5Vdc	Dark – main picture muted.

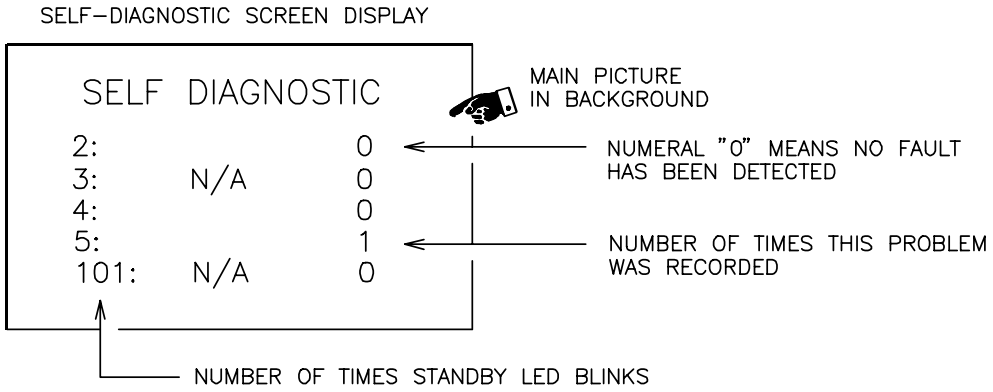
The following waveform was taken with the self-diagnostic page displayed on the TV. The waveform shows that the YM/OSD BLK signal is at an average level of 2.0 volts for the main picture brightness reduction. There are peaks of the YM/OSD BLK signal that rise to 5Vdc to mute the main picture. These peaks correspond to the self-diagnostic OSD characters. By muting the main picture at this time, the OSD letters appear on the TV screen without interference from the main picture.



Channel 1 =IC301/pin 29 – OSD Blk signal. 2V/div.
Channel 2 =IC301/pin 31 – OSD green signal input. 0.5V/div.
Time base = 2msec/div.

While the main picture is at half brightness, the OSD self-diagnostic page is displayed at normal brightness and appears as an overlay to the main picture.





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